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## Waterworks Articles

**I**N an effort to reflect the general interest in the subject of waterworks, occasioned by the thirty-fourth annual meeting of the New England Waterworks Association in New York next week, the Engineering Record has devoted more than the usual amount of space in this issue to the topic which is uppermost, at present, in the minds of many of its readers. The salient features of several of the articles are commented on elsewhere in these columns, so that any further review is unnecessary. It is hoped that waterworks men will find in the following pages something of interest and value.

## Baltimore Filters Completed

**A**NOTHER important municipal filtration plant is ready for service. With the news that Baltimore's water purification works will be formally opened Sept. 13, St. Louis loses the distinction of owning the newest large-scale plant of its type in the country, although it will still retain title to the largest mechanical filtration plant in the world. One by one the big cities are abandoning the use of unfiltered surface water supplies. New York, however, is still using unfiltered water but plans for purification were prepared several years ago, bids were received for the construction of filters and the work was almost placed under contract when a sudden decision of the municipal administration consigned the project to a pigeon-hole in some desk down at City Hall. The Baltimore plant, which has been described in several articles in this journal, represents some of the latest ideas in filter plant detail, and the city has been fortunate in having had an engineer of the caliber of James W. Armstrong to control the destinies of its Lake Montebello water purification project.

## Fine Screens for Drinking Water

**A**DAPTATION of processes and methods in successful use in one industry to another field is one of the results of the broadening of the field of the engineer. In the article on page 291 there is described the use of a screening plant, common in the paper mill industry, adapted to the removal of the lower organic life from lake water. Various schemes for the removal of these macroscopic plants and animals from western waters have been tried for twenty-five years. Most of the screens have been of the vertical lift type, two screens, one ahead of the other, being the usual form. At Oakland, Lake Chabot water was formerly strained horizontally through cheese-cloth stretched over vertical frames placed in the side of a long flume. At pres-

ent a screen plant on the side of Marston Lake opposite to the one described consists of shallow square wood tanks with a second square of screen frames set in vertical slots. In all of these plants the method of washing the screens was not considered seriously by the designers. It very soon becomes a burdensome process, particularly when the "moss begins to run" in large quantities. An automatically washed screen, whose operation involves only the opening of a valve and the starting of a motor, is a desirable advance in the treatment of a lake water subject to the larger growths which cannot be kept down with copper sulphate. Growth can be removed by filters, but the difficulties from short runs and high counts are by no means to be minimized. There is no question here of hygienic purity; the hypochlorite plant takes care of the bacteria. At some future date, perhaps, the adaptation will go still farther to the sewage disposal field. Such a plant, with compressed air substituted for wash-water, is worth investigating.

## Strength of Field Concrete

**T**WO very definite conclusions can be drawn from the results of the extensive and continued testing of the concrete going into New York's subway construction, reported on page 296. First, the average strength at 28 days of 1:2:4 Portland cement concrete poured on the job in standard cylinders is only about 1500 lb. per square inch. This is 25 per cent lower than the recommended value of 2000 lb. made by the Joint Committee for the required strength of this mixture. Possibly the method of curing by sprinkling in the moist room may have decreased the strength of these specimens, as it is evident from the results in Table 2 that many cases of lower values for such curing conditions were obtained. Second, the strength of concrete specimens from the actual structure exceeds the strength of similar specimens cast on the work or made by hand in the laboratory. One cause of this strength is probably the greater chemical action in setting which occurs in the mass concrete, due to higher interior temperatures from chemical heat longer retained. The high heads of 3 to 15 ft. acting on the concrete in the structures and the resulting consolidating pressure in the forms may have produced a denser and stronger concrete, although there seems to be no direct law of increase in strength for higher heads. The comparisons given for variation of strength with other variables, while not claimed to be of much value because not independent, seem to agree, in general, with the usual results. Perhaps the most important work

being done by the Public Service Commission in its influence on the contractors is the continuous testing of the aggregates, combined with these tests of field concrete.

## Pan-American Road Congress

**F**OR the first time in their histories the American Highway Association and the American Road Builders' Association will hold this year a joint convention—the Pan-American Road Congress—which will open at San Francisco, Sept. 13, and continue in session for five days. In the past these two organizations have held separate meetings, involving a duplication of effort for which the Engineering Record can see no justification. The joint meeting, therefore, will be worth watching, and the opinions of those who attend it will be valuable as indicating whether one road convention is preferable to two meetings, both of National scope. From the program containing the list of papers to be presented the Pan-American Road Congress will be well worth while. The committee has very wisely set aside ample time for discussion and selected engineers particularly well qualified to lead the speaking from the floor. This augurs well for the success of the joint convention, for discussion of papers is always one of the most interesting features of engineering meetings. The joint congress will probably establish between the two associations closer relations than have previously existed. Whether this meeting will be the means of effecting the organization of a single National association in the highway field the future only will determine.

## Making the Little Filter Work

**T**O MAKE the little filter plant work is usually a much harder problem than to get results from a large metropolitan system. When unforeseen difficulties arise in the large plant trained experts are easily available. With the 1,000,000 to 5,000,000-gal. systems any unusual condition must be met by the superintendent. If the alum fails to produce a floc because of a colloidal turbidity his only chance is a prayer for the rain to cease and the river water to clear up. Robert Spurr Weston presented an excellent paper on difficulties from colloids in waters to the American Society of Civil Engineers several years ago. The theory was explained in detail, but it relates more to a comparatively clear colored water than to the milky fluid that flows in some of the southwestern streams. When these conditions arose at the little town of Burlington, Kan., the engineers who had installed the plant initiated a series of experiments, described on page 292, to find out what was

happening and what could be done to cut down the enormous amount of coagulant required to maintain a high standard of excellence in the effluent. The test rigs used, ordinary butter-churns for the laboratory tests and a many-baffled mixing box made by the village carpenter for the basin tests, can be duplicated at any small plant that encounters difficulties. As in most experimental work some things, not anticipated, eventually led to practical results. The whipping idea produced good results which were duplicated in practice by the mixing box. The idea of over-treating a small proportion of the water is the one adopted in many softening plants. The ability of lime to assist materially in settling certain turbid waters has long been known, but learning just how it could be used to advantage in connection with alum in the Burlington plant was worth the cost of the experiments. Perhaps a word of warning is necessary—lime may not give the same result when applied to every colloidal water. Then, too, the constituents must be known and the resulting combinations kept from producing any incrusting effect.

### Municipal Prosperity Depends on Adequate Water Supply

THE COLLAPSE of municipal prosperity is not often laid at the door of the waterworks fraternity, but many citizens of Council Bluffs feel that the failure of the old plant to furnish adequate fire protection and clean water was one of the largest factors in driving away business in the late eighties. It is probably true that several real estate holdups, such as compelled the South Omaha stock yards to abandon their original intention to locate in Council Bluffs, had no small share in forcing a decline in the population curve.

After the city's implement-manufacturing houses were burned out twice and had suffered numberless individual losses, mainly because they had to rely on one 6-in. water main which they were unsuccessful in having reinforced or enlarged, a general exodus of these firms took place, leaving the main street as deserted as a village church-yard. Boom-day prosperity, however, like a super-saturated chemical solution, is readily crystallized into stableness. On the other hand, a small amount of acidulated discord and greed may disassociate and dissolve what has already been crystallized into an indifferent watery solution of distrust, depreciation and insolvency. The water controversy furnished the acid.

Council Bluffs was once, and had the chance to continue to be, the great city of the plains. From a railroad standpoint it is unequalled in location as a distribution and gathering point, but its citizens chose discord rather than harmony and its neighbors grabbed the prize while they haggled. It is not the intention to discuss the merits of the waterworks controversy, for few outsiders are interested, but the fact remains that once this property was rehabilitated the city as a whole began immediately to regain some of its former prosperity.

The downward dip of the population

curve has now been reversed. Few deserted business buildings exist. Dwellings by the score are going up in many parts of the city and the beautiful bluffs for which the city was named are gradually becoming populated. No one could build on the higher levels so long as water was unobtainable, but that condition of affairs is now changed and, as stated in the article on page 286, the waterworks officials have gone so far as to spend \$30,000 to furnish water to only seventy families, in the belief that this bluff territory will be built up rapidly. To Denver, San Francisco and a number of other cities bickering over the water question, the experience of Council Bluffs certainly ought to be illuminating. To waterworks officials whose duty it is to serve their customers efficiently the responsibility of municipal welfare is defined in no uncertain terms.

### Help for the Make-It-Work Man

A CLOSE relation between the technical data-taking force of a waterworks system and the operators is gradually becoming the rule rather than the exception. Piling up records for the chief engineer's files does the man who is actually running the plant no good. That the latter must have the information or receive orders based on the latest tests at the earliest possible moment, if it is to be of any use in most of the adjustments around a purification works, was long ago conceded though not always lived up to.

In the boiler room of many plants carbon-dioxide tests are now made and immediately posted, so that the fireman can know the condition of his furnace at all times. Such a system, carried out at St. Louis last year, effected a saving over the previous year of 14.2 per cent in the amount of coal consumed. There are still a few places where such a valuable test as a turbidity reading is not made frequently. Even on such an erratic river as the Missouri this simple determination is not made in one plant more often than twice a week, yet an analyst is in charge of the purification process and doubtless carries out regularly tests for free and albuminoid ammonia, when the same time put on the field tests would prove far more profitable. In Denver bacterial results are telephoned to the operators as soon as the counts are made, and turbidity readings are made daily by the filter attendants.

On-the-spot tests are best if practicable. Take, for instance, the road inspector's problem. If sand and gravel of doubtful character for concrete should be delivered on the job, any immediate condemnation depends on judgment, and there may be a wide variation in what different inspectors will pass. If the inspector has means at hand to make his tests on the job, his own moral fiber is strengthened and he has something tangible on which to base an opinion in doubtful cases. On a recent inspection trip with a highway engineer the question of accepting a sand, obviously finer and more ungraded than that specified, was under discussion. The sand was not of marked inferiority, so it was hard to ex-

plain to the contractor why this kind of material would not make a good concrete, whereas if an adequate test could have been made on the spot no further argument would have been necessary. Fortunately for road construction, as well as for waterworks operation, there is now available field apparatus which will give the man on the job the necessary information to sustain his decisions. It only remains for the man in the field to make use of what is available, and for the man in charge to see that he is supplied with the proper tools and instructed how to use them.

### Air-Bound Filters

THE CLOGGING of water filters by air entrained in the interstices of the sand bed is a normal phase in the operations, from time to time, of many municipal plants. The output of a filter between cleanings can be markedly reduced by entrained air, even to an extent exceeding that produced by clogging with silt and clay as found in most river waters. The removal of air-binding and its effects should be an important function of filter-cleaning arrangements, which differ materially at different places.

Unusual experiences with air-bound filters at Wilmington, Del., are described by Edgar M. Hoopes, Jr., chief engineer of the Wilmington Water Department, in an article appearing on page 282 of this issue. The Wilmington data deal with the performances of a so-called slow sand filter plant, the upper portions of the sand layers of which are cleaned hydraulically by a Blaisdell washing machine. Wash-water under pressure is forced through perforations in the hollow vertical teeth of the horizontal stirrer wheels which penetrate into the sand for some distance below the surface. The dirty wash-water with the accumulations detached from the sand is confined to the lower compartment of the moving machine, whence it is pumped into suitable outlet troughs. The revolving stirrer wheels, with their teeth penetrating the sand to any desired depth, are located in the moving lower compartment which is sealed to the sand surface with special shoes, and from which more water is pumped than is delivered through the perforated teeth.

The Wilmington data are of particular interest in that they represent five years' experience at a sizable plant with a Blaisdell washing machine operating on slow sand filters, the yield of which has been at a rate somewhat higher than is the ordinary practice with slow sand filters elsewhere, which are cleaned by draining the sand bed and scraping off the upper portion. The Wilmington plant thus occupies, in some respects, a somewhat intermediate position between an ordinary slow sand filter and a mechanical or rapid filter.

Air-binding is not a new development in the field of water filtration. It was observed by Mr. Kirkwood to be a feature of the sand filters of Europe upon putting the filters back into service after they had been drained for scraping, and he suggested fill-

ing them with water applied from below in order to drive out the air. It is believed that this suggestion of Mr. Kirkwood's, contained in his classical report on the filtration of river waters for the city of St. Louis in 1869, was quite generally adopted abroad where construction arrangements so permitted. It was also known then that sand filters should be cleaned before the loss of head became excessive, although it is doubtful if the operators appreciated fully the complications arising from the formation of a partial vacuum within the pores of the sand bed and the consequent liberation of air, as explained by Mr. Hoopes.

Liberation of air was a characteristic of the water filters of the Lawrence Experiment Station, and at the Lawrence city filter the complication of released air was added to by the presence in the pores of the sand of air trapped there as the result of operating the city filter intermittently, that is, draining it each day and filling the sand with water applied from above.

Mechanical filters in their earlier days, when relatively coarse sand was employed with fairly low acting head, as in the case of the old Warren filters, did not give serious trouble from air-binding. This complication developed, however, with the advent of fine sand and the utilization of a greater acting head than the depth of the water above the sand surface. Undoubtedly there are mechanical filters which have suffered from unequal and inadequate arrangements for cleaning the sand bed by applying wash-water from below. The problem has been complicated through patent litigation until to-day the subject is in need of a comprehensive review of available evidence.

Wilmington's experiences are striking as regards the increase in the initial loss of head noted with the local filters as they have continued in service, and the reduction in the yield of water filtered between cleanings. The leaky filter bottom and inability to displace air by applying water to the bottom of the filter when most needed is, of course, an abnormal feature, but the extent to which the compacting of the sand bed through changes therein is normal to that process of filter cleaning is a problem of much practical significance.

The speed with which a water filter may be cleaned hydraulically, as compared with the time-consuming task of draining slow sand filters, scraping them and refilling them from below to displace the air and thus guard against vertical channels through which a part of the applied water may pass at abnormally high rates of filtration, is an advantage that filter operators will always appreciate. The Blaisdell washing machine gives to the slow sand filter some of the advantages of a mechanical filter and modifies and lessens some of the disadvantages of the slow sand filter. In the final analysis of the proposition of selecting a method of filtration data should be compared on the basis of relative costs by the different methods of producing filtered water uninterruptedly of satisfac-

tory quality in each instance. Further data from Wilmington will be awaited with interest.

### The New England Waterworks Association's Development

SCIENTIFIC and professional societies, like individuals, have their periods of youth, manhood and senility, but the New England Waterworks Association is perpetually young. Some associations have been through periods of buoyancy and depression, but this one seems always to be prosperous. The gray hairs of the old leaders appear to be no deterrent to enthusiasm, while they add to solidarity. The convention which, according to a long established custom, is held during the week of Labor Day, this year in New York, brings to mind the fact that the association is now a third of a century old. It will not be out of place, therefore, to call attention to its growth and influence.

At the end of its first year it had 27 members; after ten years, 338; after twenty years, 522; after thirty years, 666; and now, in round numbers, about 700, exclusive of honorary and associate members. During its three decades it has maintained a quarterly journal, modest in form, substantially uniform from year to year, well edited and well printed, containing a long series of scientific papers, practical articles and committee reports of a high order of merit. It is hard to find a journal more uniformly satisfactory. The association's financial policy has been sound, the dues have been relatively low, \$3 a year, and there is a contented feeling among the members, for they realize that they are getting their money's worth.

What lessons can these wise men of the East, in waterworks convention assembled next week, teach the scientific men of the country in the way of organization? In the first place the object of the association is definite and limited. It concerns water supply, a broad subject to be sure, but one which, nevertheless, has a central idea and exerts a centripetal force. A large percentage of the members live near enough to the headquarters in Boston to be able to attend the meetings with regularity. Thus business acquaintances have ripened with the years into firm friendships, and the superintendents attend the meetings, not merely to hear a paper by some noted engineer, but to meet some other superintendent and learn what he thinks about the subject, feeling sure that, though the paper itself be highly technical, some informal practical discussion will arise which will make up for an overdose of science. Within the little section of New England the water supply problems are much alike so that feelings of mutual interest naturally arise.

Wisdom has been shown in keeping the management very largely in the hands of the active waterworks men, and neither the professional engineers nor the supply men have been unduly prominent. Yet it has been recognized that all three classes of men have a necessary part to play—the

engineer to design, the manufacturer and salesman to furnish supplies, the superintendent to build and operate. Then, too, there are the waterworks clerk, the contractor and the water analyst.

Wisdom has been shown again in making the journal a quarterly, for a monthly is too expensive for a small association, while an annual is too unresponsive. It is difficult to get authors to prepare manuscripts in time for monthly issues, and authors naturally dislike to have their papers remain unprinted for perhaps a year. Generally speaking, it is a good rule for societies which meet monthly to maintain a monthly journal, for societies which meet quarterly to maintain a quarterly journal and for societies which meet but once a year to publish but one volume of proceedings a year.

Again wisdom has been shown in arranging the times of holding the regular meetings—that is, during the winter months, when the superintendents' duties are less active, although no superintendent will admit that his work ever stops.

The association has been fortunate in having several sources of influence concentrated in Boston, the State Board of Health, now known as the Department of Health, the Metropolitan Waterworks, and the Massachusetts Institute of Technology. These have been training schools for waterworks men, who, although now scattered over the country, still retain their membership in the association and occasionally drop in at the meetings, sure to find old acquaintances. In future meetings, however, they will fail to find one who has just departed, Dexter Brackett, the chief engineer of the Metropolitan Water Board and past-president of the association. His tall form, his genial smile and his helping hand will be sadly missed.

The New England Waterworks Association has never maintained standing scientific committees, yet it has done a great amount of excellent committee work. Recent examples are the reports of the committees on yield of drainage areas, meter-rates and statistics of filtration plants. Another important report on service pipes is to be presented at the New York meeting, next week. Subjects are taken up for committee study when they are fresh and when the need of concerted action is obvious. The result is that when a report is issued it becomes a mile-stone for that particular subject.

Thus from a small beginning the association has reached a period in its development at which it is one of the dominating influences in the waterworks field. It may well be taken as a model of what such organizations should be. There exists among the members an esprit de corps which means everything for the success of the association. A good example of the loyal spirit which pervades the organization is furnished by the decision of its president, Leonard Metcalf, to make the trip from San Francisco to New York and then back again for the express purpose of being present at the convention next week.

# Air-Bound Filters the Chief Difficulty in Operating Wilmington's Water Purification Plant

Negative Head Induces Liberation of Air in Beds During Winter—Cracks in Floor of Filter Complicate Problem—Dynamite Used to Break Ice on Beds—Effects of Sand-Washing Machine Discussed

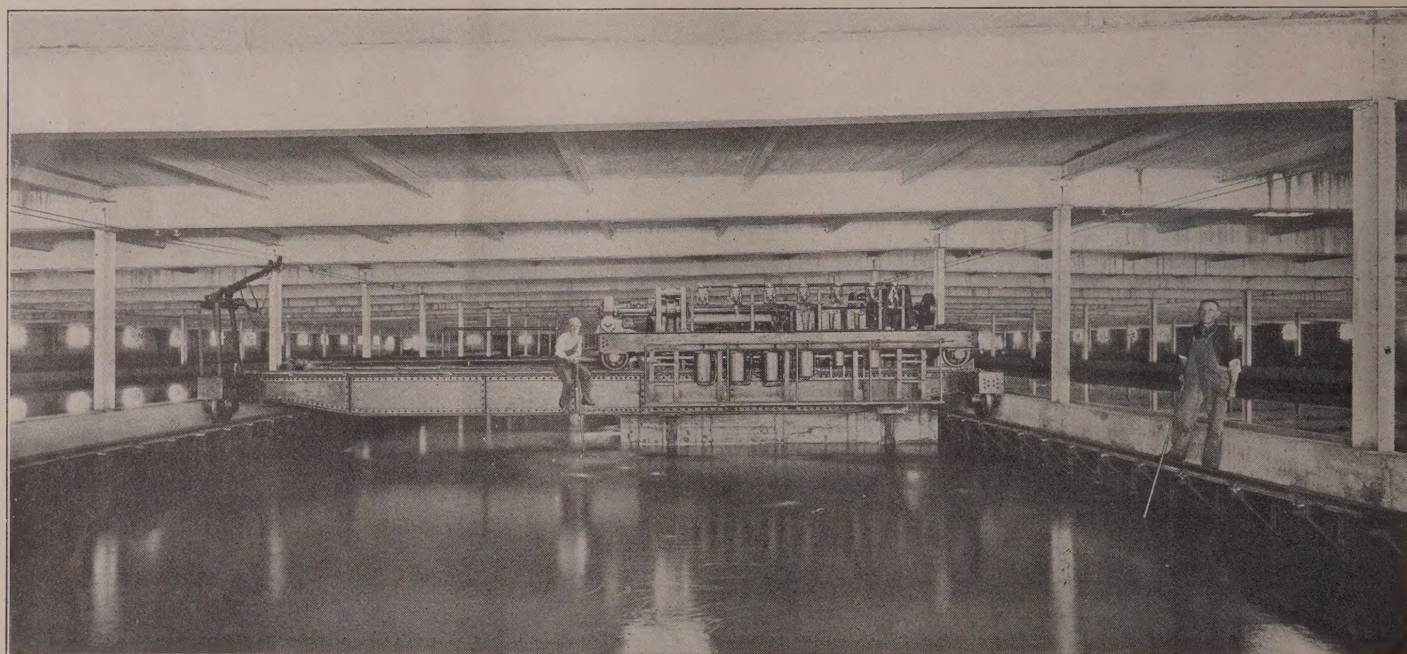
By EDGAR M. HOOPES, JR.

Chief Engineer, Water Department, Wilmington, Delaware

ONE of the principal difficulties encountered in the operation of water purification plants is due to the liberation and entrainment of air within the filter beds. This phenomenon, which occurs in filters of both the rapid mechanical and the slow sand types, has become a subject of great interest to sanitary engineers. Especially is this true as regards slow sand filters, where the action of collected air is of serious moment, frequently preventing the passage of water through the beds. Before describing a most

the filtration of waters containing large amounts of air in solution. Of further interest is the fact that at summer temperatures water is cooled in the process of filtration, while in winter a slight rise of temperature occurs. Although the actual temperature difference between the applied and filtered water may not be great, it follows that the tendency of water is to absorb air from filter beds in summer and to release it within the beds in winter. This in turn explains why air-binding troubles are

by 362 ft. long and are constructed to accommodate a Blaisdell sand-washing machine. The underdrainage system consists of one row of Brossman tiles laid longitudinally down the center of each bed, the collected filtrate passing through holes in the floor under the underdrains into a discharge pipe hung close to the roof of the filtered water reservoir. Each discharge pipe is equipped with a Venturi meter through which the filtrate passes into the main effluent collecting pipe and thence into



FILTER SAND IN THE LONG, NARROW BEDS OF THE WILMINGTON PLANT IS WASHED BY MACHINE

unusual condition of air-binding which occurs at Wilmington, Del., under certain conditions of temperature in the applied water, a brief review of the theory of the subject may be of interest.

## NEGATIVE HEAD IN FILTERS

The amount of air absorbed by water under atmospheric pressure varies almost inversely as the temperature. If the latter remains constant any decrease in pressure will tend to decrease the absorption coefficients of the two principal gases composing air—oxygen and nitrogen. If the pressure remains constant these coefficients will increase as the temperature decreases, complete saturation of water occurring at about 0 deg. C. When the loss of head through a filter becomes greater than the depth of water over the sand a negative head is formed and the pressure in the interstices of the sand and gravel becomes less than atmospheric. The effect of this reduction of pressure is to permit a portion of the air to escape from the water in process of filtration.

This point clearly indicates that negative heads cannot be successfully employed in

severest at low temperatures—the question of negative head being neglected. Ordinarily water will contain about twice the volume of air in solution during winter as compared with summer temperatures. During the latter period filters may frequently be operated under a considerable negative head before the release of air is evidenced in objectionable quantities, while such a procedure in winter, when water is about at its saturation point, is immediately followed by disastrous results. So much for the physics of the problem—the results of actual experience are far more interesting.

## FEATURES OF THE PLANT

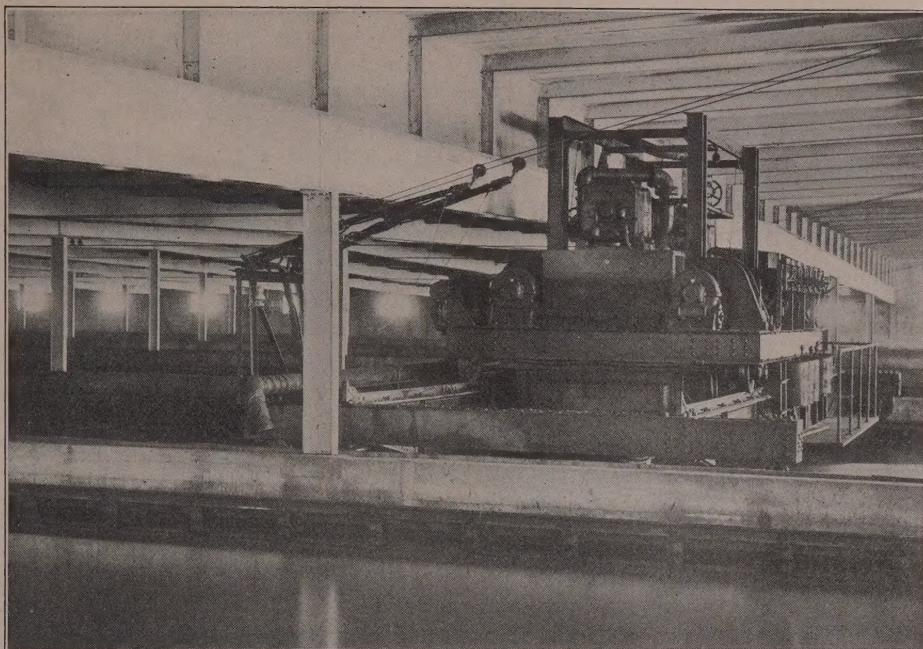
The slow sand filter plant at Wilmington, Del., described in the Engineering Record of Nov. 20, 1909, page 564, embodies many radical departures in points of design. Six covered sand beds of  $\frac{1}{2}$  acre each in area are superimposed upon a filtered water reservoir of 6,000,000-gal. capacity. The complete structure, therefore, is two stories high, the reservoir or lower story having a groined arch roof which also serves as the floor of the filters. The beds are 40 ft. wide

the filtered water reservoir. Reference to the illustration will make the design clear.

The filtering material consists of 9 in. of crushed stone, 5 in. of graded gravel and 24 in. of sand, the latter having an effective size of 0.23 mm. and a uniformity coefficient of 1.83. Water enters the filters by gravity through a chamber where the head on the beds is controlled by a manually regulated disc valve. The depth of water on the beds is maintained at 52 in., while the rate at which the plant is operated varies from 4,000,000 to 6,000,000 gal. per acre per day.

## FILTER FLOOR CRACKS

The plant was completed and placed in operation Jan. 16, 1910, and immediately it was found that longitudinal cracks had developed in the floor of the filters or roof of the filtered water reservoir, thus allowing the effluent to pass directly into the reservoir underneath instead of taking the intended route through the underdrains and effluent pipes. Before final payment on the plant was made the contractor was required to calk these cracks with lead wool, the calking being done from the inside of the reservoir against the direction of pressure. This



SAND-WASHING MACHINE DISCHARGES DIRTY WATER INTO LONGITUDINAL GUTTER

method was the only one available without removing the filtering material and was apparently successful. For the first two years' operation the beds remained tight and the effluent delivered was at all times of satisfactory sanitary quality and appearance.

In January, 1912, air-binding trouble was experienced for the first time, and the successful operation of the beds was seriously impaired. Beginning on the fourth day of this month the temperature dropped to 5 deg. below zero and remained below freezing almost continuously until the middle of February. Heavy ice formed upon all of the filters, rendering the operation of the Blaisdell washing machine impossible. During this period the water was completely saturated with air and as the beds could not be washed, they became so badly bound that filtration was completely arrested. Under this condition it was evident that the plant would either have to be abandoned entirely or radical measures adopted to break the ice and permit the washing machine to be used.

#### ICE DYNAMITED

Efforts to remove the ice by ordinary means having failed, 40 per cent dynamite was employed, four  $\frac{1}{4}$ -lb. sticks being placed below the surface of the ice on each bed and exploded. This method was successful in shattering the ice, which by this time was from 6 to 10 in. in thickness. The washing machine being again in operation, it was found that the delay in cleaning the beds had permitted an excessive negative head to form and that air-binding and compacting of the sand existed at a depth below the reach of the washing machine teeth. This condition was relieved by backfilling under pressure with the applied water for a period of about two hours, during which time unfiltered water was delivered to the city.

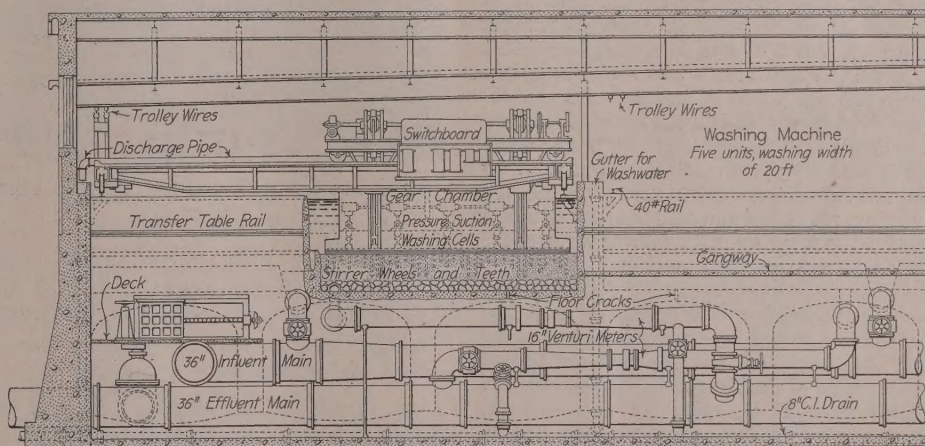
Following the use of dynamite, which was certainly justified under the circumstances then existing, the calking in the floor cracks became loosened and at least one-half of all water filtered (about 11,000,000 gal. per day) passed through this route to the reservoir underneath. The result of this occurrence was the loss of control of the rate of filtration on those beds where leakage was of any amount, the rate being ex-

cessively high in the area over the cracks and low over the remaining portion of the bed. The following winter, 1913, being much milder in temperature, a recurrence of the trouble appeared in a decidedly less severe form. It was found during this period that repeated expansion and contraction of the concrete filter building had seriously aggravated the cracks in the filter floor which in some cases were from 1 to 2 in. in width, running practically the entire length of the

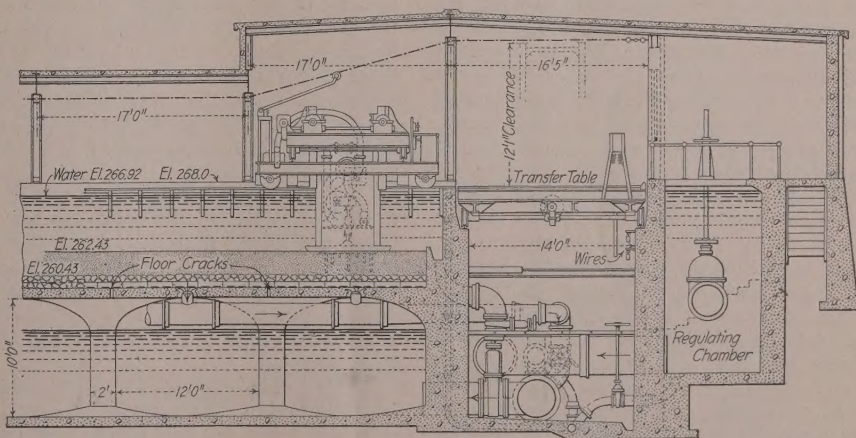
bed, 362 ft. Lateral hair line cracks also developed, running completely across the filters at intervals of about 40 ft. A careful inspection of the cracks established the futility of attempting any further efforts at calking. It was found during this winter that a definite relationship existed between the intensity of air binding and the leakage through the beds, the worst disturbances always occurring on those beds in which the leakage was greatest. Around the establishment of this point hinges a most interesting condition.

#### EFFECTS OF LEAKAGE

The usual method of operation at Wilmington is to wash or rake each bed when the loss of head reaches 72 in. This, it will be seen, embodies the use of a negative head of 18 in., since the depth of water on the bed is but 54 in. No liberation of air will occur during the average spring, summer or fall under such operating conditions if the loss of head is not allowed to exceed this experimentally determined maximum. It is of extreme significance to note that the leakage through the beds during periods of warm or mild weather is negligible, the entire filter structure having expanded until the fissures in the concrete filter floors are nearly closed. At such times a negative head slightly greater than 72 in. may be employed as a matter of operating economy, the air which collects in the beds being easily expelled by draining the water down and backfilling under a slight pressure with filtered water from one of the full beds immediately adjoining. This method of operation has been repeatedly employed without injury to the filtering material or affecting the quality of the filtrate. During periods of low tem-



Transverse Section



Longitudinal Section

RELATION OF FILTERS, UNDERDRAINS AND FILTERED WATER RESERVOIR

perature, when the maximum contraction has taken place in the concrete flooring of the beds, a similar backfill is dissipated as leakage through the cracks, and it is impossible to establish a pressure sufficiently great to expel the collected air.

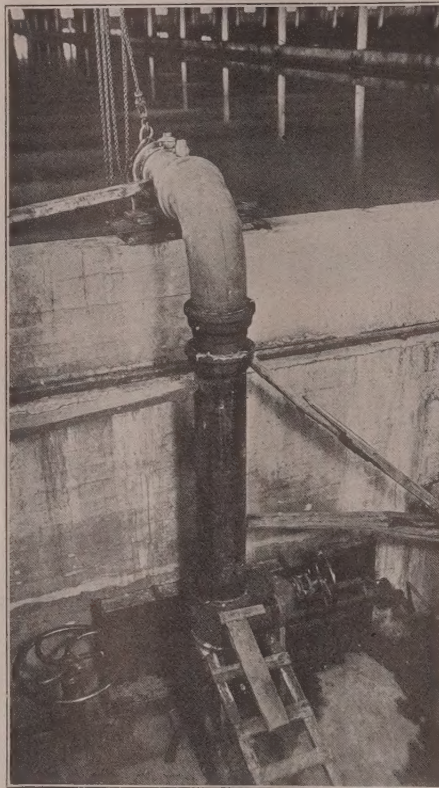
At this point the true significance of the situation becomes evident. When the full flow of water is not maintained through the leaks, which occurs when the head becomes slightly negative and the pressure within the filter falls below atmospheric, air is drawn through the cracks from the filtered water reservoir below and stops the process of filtration completely. This action cannot occur in warm weather since the fissures are almost completely closed by expansion, as has already been stated. It will thus be seen that the location of the filter beds over the filtered water reservoir has resulted in a condition which is in many respects unique. The behavior of air in the Wilmington filters is evidenced by a high initial loss of head after cleaning or scraping, the air collecting in the gravel directly below the sand layer. The location of the air is the same, whether it be liberated from the water in process of filtration or drawn up from the filtered water reservoir through the cracks in the beds.

#### BACKFILL WITH PUMP TO EXPEL AIR

During the past two winters excessive air-binding, due to the conditions described, has been partially overcome by attaching a centrifugal pump to the effluent pipes from each bed and backfilling under a pressure just sufficient to expel the air. The pump takes its suction from the filtered water reservoir and the rate of backfilling is varied from 1,500,000 to 3,000,000 gal. per acre per day, depending on the amount of leakage through the bed under operation. A pressure of 3 lb. has been found sufficient to expel the air from a bed which has been drain down, while 6-lb. pressure is required when the full depth of water exists. As the magnitude of the cracks in the flooring is becoming progressively worse with repeated expansion and contraction of the building, plans are now under preparation to remove the filtering material and waterproof each bed with asphalt and felt.

It has been suggested to the writer that part of the trouble at Wilmington might be due to the mechanical washing of sand by the Blaisdell machine. As this method of cleaning is of fairly recent introduction a brief account of its operations is necessary. The washing machine may be described as a traveling crane spanning a filter unit and supporting a watertight rectangular chamber containing the essential washing machinery and further provided with means of lowering this chamber to the sand surface and traversing over the filter while the operation of washing the sand is proceeding. The washing chamber may be raised to clear the rim of the filter, and the machine removed to another unit by the transfer carriage. The washing chamber is subdivided into two compartments, the lower or suction chamber, from which the dirty wash-water is withdrawn, containing five horizontal stirrer wheels supported on vertical shafts. The upper or dry chamber contains the driving mechanism for the stirrer wheels and also the pressure and suction pump. The stirrer wheels are equipped with numerous hollow perforated teeth which can be varied in length for the purpose of washing to different depths. Water for the pressure pump is taken from the

raw water of the filter and supplied to the perforated teeth while the suction pump withdraws not only all water discharged through the teeth, but a slight amount in excess, which is drawn from the filter bed. In operation, the teeth scour the sand and the wash or pressure water drives the dirt up into the suction chamber where it is withdrawn and discharged into a wash-water gutter before the machine passes a given point. As the suction is always in excess of the pressure supply a certain amount of clear water is drawn into the area being washed, thus preventing the dirty or wash-



DURING AIR-BINDING SIPHON DREW WATER FROM TOP OF BED

water escaping from the chamber. The chamber is sealed to the sand surface by wide hinged shoes extending in the front and rear.

#### RESULTS OF SAND-WASHING

The result of thus washing the sand in place has been found to increase the clogging effect when the beds are slightly air-bound. This is undoubtedly due to compacting of the sand under the combined influence of leakage and negative head. No evidence of sub-surface clogging has ever been discovered, a point which might be suggested from the possibility of forcing the finer particles below the upper surface of the sand through the action of the stirrer wheel teeth. As a matter of fact, the tendency of the Blaisdell machine is to increase the effective size of the sand, the finer particles passing out with the wash-water. This action may be controlled with fair accuracy by increasing the duty of the pressure and suction pumps until a velocity is reached sufficient to hold the finer particles of sand in suspension.

Table 1 clearly shows the results obtained at Wilmington, the samples of sand being collected from the top of the bed immediately after washing.

Sand analyses were not made during the

TABLE 1—ANALYSES OF SAND FROM WILMINGTON FILTERS

| Year | Filter Bed | Effective Size, mm. | 60 Per Cent finer than, mm. | Uniformity Coef. |
|------|------------|---------------------|-----------------------------|------------------|
| 1910 | E          | 0.24                | 0.39                        | 1.63             |
| 1911 | E          | 0.22                | 0.36                        | 1.64             |
| 1914 | E          | 0.29                | 0.43                        | 1.48             |
| 1915 | E          | 0.33                | 0.375                       | 1.44             |

missing years. Contrasted with this gradual change from a finer to a coarser sand, the average results of the entire plant, in Table 2, are of interest.

TABLE 2—AVERAGE RESULTS OF ENTIRE PLANT

| Month     | Av. initial loss of head at a 3 mil. gal. rate after washing, in. | Average yield after washing, gal. |
|-----------|-------------------------------------------------------------------|-----------------------------------|
| July 1910 | 3.8                                                               | 13,082,000                        |
| 1911      | 7.25                                                              | 12,719,000                        |
| 1912      | 14.67                                                             | 7,538,000                         |
| 1913      | 11.17                                                             | 6,228,000                         |
| 1914      | 22.8                                                              | 3,920,000                         |
| 1915      | 20.67                                                             | 5,782,000                         |

A summer month is selected for the purpose of illustration, since the behavior of the filter is normal, leakage through the beds being at a minimum. From Table 2 it will be seen that the average initial loss of head at a 3,000,000-gal. rate has increased with but two exceptions, from 3.8 in. in 1910 to 20.67 in. in 1915, while the yield after washing has decreased from 13,000,000 gal. in 1910 to about 6,000,000 gal. in 1915. The figures representing the average yields, give the amount of delivery from the time a bed is washed until it is first raked. The exact cause of this condition has not as yet been determined but is being studied with great interest.

### St. Louis Engineers Test Filter Controllers

Results on Two Types Were Checked by Three Methods—a 6-Inch Disc Meter, a Venturi Meter and a Standard Weir

TESTS on two types of 24-in. filter rate-controllers for use in the plant of St. Louis were made previous to equipping the filters with them. Specifications called for the maintenance of a rate of flow not to exceed 3 per cent from the average between the limits of 1,500,000 and 2,500,000 gal. daily, with a variable head on the controller ranging from 1 to 14 ft. Between 2,500,000 and 5,000,000 gal. the variation was not to exceed 1½ per cent. Reports of the test are given in the 1914 annual report of the water department, from which the following notes are taken:

#### ARRANGEMENT OF APPARATUS

The tests were conducted in the filter house then under construction. The water used in the test was pumped from basin 5 by a motor-driven centrifugal pump with a capacity of about 3200 gal. per minute installed on the edge of the basin under a temporary cover. The pump discharged into a 12-in. cast-iron pipe line in which were placed two 6-in. disc meters connected in parallel. After passing the meters the line branched into two 12-in. pipes leading to two adjoining filter boxes, from which the rate of flow was governed by the controllers. The area of each filter box is 1578 sq. ft., including the central gutter. No filtering material has been placed in either box so that a total variation of static head of 8.5 ft. could be obtained in each test. The elevation of the water in the basin was measured with a rod

resting on the strainer system. The 24-in. effluent pipes of these filter boxes were each connected to a 24 x 10-in. horizontal Venturi tube, which operated the controlling device of each apparatus, and with a vertical ell connected to a flume leading to a measuring weir built under the groined arches supporting the filter boxes. The weir channel was 25 ft. long, 7 ft. wide and 2½ ft. deep below the crest, the sides and ends extending 2 ft. higher. The weir was a rectangular notch 44 in. wide, cut out of a steel plate ½-in. thick. Seven feet back of the weir a stilling box 5-in. square was built, in which was placed a hook gage equipped with a vernier, controlled by a micrometer adjusting screw, and reading to 0.001 ft. The weir channel contained two baffles, the first made of 2-in. lumber containing 100 holes 2 in. in diameter; being placed 5 ft. from the upper end of the channel and the second baffle, made of ordinary fly screening, 3 ft. ahead of the first. The baffles practically broke up all wave motion due to the incoming water and gave a smooth flow in the channel above the weir.

#### RATES CHECKED THREE TIMES

Three measurements of the rate of flow, one by the 6-in. disc meters, one by differential glass tubes connected to the Venturi meter and one by the weir, gave checks on the controller's record. The disc meter indicated about 2 per cent greater quantity of water than the weir and the differential readings from the Venturi tubes indicated the same quantity as the weir if a coefficient of 0.995 for small flows to 0.975 for the larger flows were chosen in the Venturi meter formula. The weir measurements are based on Fteley & Stearns formula for all heads on the weir under 0.5 ft. and Francis' formula for heads greater than 0.5 ft.

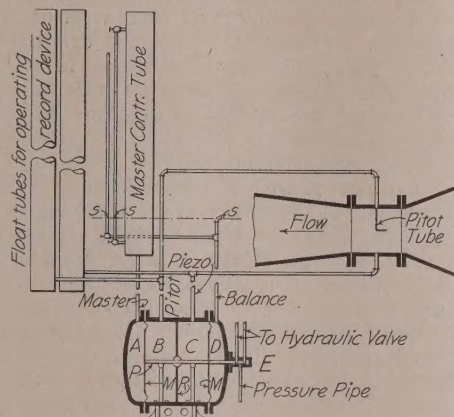
The method of operation was as follows: Starting with the filter box full or empty, as the case might be, giving a head of 12.5 ft. or 4 ft. on the controlling Venturi meter, the water was gradually lowered or raised in the filter box producing a gradual variation of head similar in the first case and opposite in the second to variation of head actually produced in filtration, but more rapidly than would likely occur in practice.

Both controllers tested utilized the principle of the Venturi tube for regulating the throttling valve on the 24-in. effluent pipe. Controller A had a small pitot tube in the center of the throat of the Venturi tube and passing out through the wall at the top, and a piezo tube connected to the bottom of the throat. Both of these tubes (¾-in. pipe) were connected to a cast-iron cylinder about 24 in. long and 20 in. in diameter called the "controller," located on the floor under the groined arches. This cylinder contained four compartments. Compartments A, B, and C, D were separated by two 16-in. circular plates, MM, connected by a small rod, P, and both plates connected to the walls of the cylinder by a thin fiber diaphragm. The rod connecting the plates, MM, passed through the bulkhead R, and connected to it by a small diaphragm to eliminate friction or leaks which might be caused by a stuffing box. This rod connected to a pilot valve E and with a very small movement allowed water from a pressure line to operate the hydraulic lift gate valve connected to the ell beyond the controller on the effluent pipe. Branch lines from the piezo and pitot tubes were connected to separate 6-in. float tubes,

where floats in connection with a clock operated a recording device showing the rate of flow. Compartments A and D were connected each to a 6-in. tube called the "balance" and "master" tubes.

#### MASTER AND BALANCE TUBES

To operate the controller the master and balance tubes were filled to some arbitrary height, SS. Water was then allowed to enter the Venturi tube, raising in connection float tubes to the height of the water in the filter box. The water in the master tube was then raised to a point above S, equal to the calculated height the water in the pitot tube would exceed the water in the piezo tube for the desired rate of flow. This excess head in the master tube would move plates MM and pilot valve E, allow-



DETAILS OF CONTROLLER SET UP FOR ST. LOUIS TEST

ing the water from the pressure line to open the throttling gate-valve in the effluent line until the excess head in the pitot tube over the piezo tube would equal or slightly exceed the difference in head of the "master" over the "balance" tubes and move plates MM and pilot valve E back to neutral position.

Controller B, which is manufactured by the Builders Iron Foundry Company, consists of the same size of Venturi tube with the down stream converging section changing to a 12 x 24-in. rectangular section connecting to a butterfly throttling valve, consisting of two 12 x 12-in. vanes hinged in the middle and operated by spur gears engaging a double ratchet direct connected to a 10-in. hydraulic cylinder. The head and throat of the Venturi meter were each connected to a 6-in. float tube with ¼-in. pipe. The floats in these tubes operated a set of differential gears and cam which in turn operated a lever connected to a small pilot valve. Like valve E of controller A this pilot valve allowed water to enter the hydraulic cylinder operating the throttling valve on the effluent line. The differential gear also operated another cam which moved a pointer over a graduated scale, showing the rate of flow and also moved a pen over a chart which was moved by clock-work recording the rate of flow. A third 6-in. float tube connected to the filter box also operated a differential gear in connection with the tube connected to the head of the Venturi tube, which moved a recording pen over the chart showing the loss of head and also the elevation of the water in the filter box. The recording apparatus was not put in operation, as no doubt existed as to its reliability.

C. M. Daly, assistant engineer in charge

TABLE 1.—CONTROLLER A  
Rate of Flow, Million Gallons Per Day. Per Cent Variation.

| Test No. | Maximum. | Minimum. | Average. | *Max.-Min. Average. | Max.-Av. Average. | Av.-Min. Average. |
|----------|----------|----------|----------|---------------------|-------------------|-------------------|
| 2        | 1.640    | 1.395    | 1.563    | 15.67               | 4.93              | 10.74             |
| 4        | 1.690    | 1.433    | 1.610    | 12.36               | 4.97              | 7.88              |
| 3        | 2.140    | 1.987    | 2.093    | 7.31                | 3.24              | 5.06              |
| 6        | 3.070    | 2.990    | 3.035    | 2.63                | 1.15              | 1.48              |
| 5        | 3.775    | 3.292    | 3.487    | 13.85               | 8.26              | 5.59              |
| 1        | 3.965    | 3.865    | 3.916    | 2.55                | 1.25              | 1.30              |
| 7        | 5.020    | 4.955    | 4.978    | 1.30                | 0.84              | 0.48              |

\*Maximum less minimum rate divided by the average rate.

of the tests, made the following comments: The accompanying tables show controller B superior in controlling the rate of flow, except in the nominal 5,000,000-gal. rate, where the variation is 0.35 per cent more than controller A. The tables also show that controller B has a nearly uniform decreasing variation in rate, from 1,500,000 to the 4,000,000-gal. rate and an increasing variation in the succeeding rates above the 4,000,000-gal. rate. Controller A shows a decreasing variation from the 1,500,000-gal. rate with the erratic action, as in test 5, that characterized the device throughout the entire time of preliminary testing for two weeks preceding the final test. Controller B presents a distinct advantage in having all the delicate parts on the operating floor easily accessible and also better proportioned piping and float tubes with an efficient throttling plug on the pressure line near the pilot valve, which, in a large degree, accounts for the better results obtained. Controller B, while more desirable than Controller A, has several features which should be corrected and probably will be in the machines furnished. Among them is the lack of positive closing action of the pilot valve and lack of any scale for setting the rate of flow.

In Tables 1 and 2 the average rate was obtained by multiplying each observed rate by one-half of the time interval between the preceding and following observed rate, and dividing the sum of these products by the total time.

TABLE 2.—CONTROLLER B  
Rate of Flow, Million Gallons per Day. Per Cent Variation.

| Test No. | Maximum. | Minimum. | Average. | *Max.-Min. Average. | Max.-Av. Average. | Av.-Min. Average. |
|----------|----------|----------|----------|---------------------|-------------------|-------------------|
| 13       | 1.575    | 1.470    | 1.520    | 6.91                | 3.62              | 3.29              |
| 12       | 2.087    | 1.987    | 2.040    | 4.90                | 2.30              | 1.60              |
| 6        | 2.975    | 2.907    | 2.942    | 2.31                | 1.12              | 1.19              |
| 7        | 2.975    | 2.915    | 2.937    | 2.04                | 1.29              | 0.75              |
| 8        | 4.020    | 3.957    | 3.987    | 1.58                | 0.83              | 0.75              |
| 10       | 4.987    | 4.905    | 4.959    | 1.65                | 0.56              | 1.09              |
| 11       | 6.155    | 5.890    | 5.999    | 4.42                | 2.60              | 1.82              |

\*Maximum less minimum rate divided by the average rate.

The work was carried out under the direction of Gurdon G. Black, engineer in charge of the supply and purifying section, reporting to E. E. Wall, water commissioner.

WISCONSIN'S HIGHWAY COMMISSION planned and supervised \$8,870,000 worth of road construction for the three years ended June 30, 1914. More than 3000 sections of road were surveyed, plans were issued for 2800 sections of road, about 2100 separate road construction jobs were actually completed, and 1569 county and State-aid bridges were surveyed.

## Council Bluffs Waterworks Regeneration Reverses Slump in Population Curve

How Municipal Ownership for 3½ Years Has Provided Adequate Fire Service, the Lack of Which Drove Away the Great Implement Business

**B**OOM DAYS for Council Bluffs, the period from 1863 to 1890, following Abraham Lincoln's designation of that city as the eastern terminus of the Union Pacific Railroad, might have been crystallized into permanency so far as many businesses were concerned except for the water problem. On Main Street several solid blocks of Eastern farm implement companies made Council Bluffs their distributing point for the rapidly developing contiguous country. The city was connected with Chicago on the east by six railroads, to the north by two, south by three and to the west and northwest by three lines, all of which had exceptionally good trackage facilities. The companies were reluctant to move elsewhere, but were compelled to do so from the inadequate waterworks fire service (one 6-in. main) which permitted practically the whole section to be burned out twice. Insurance rates became prohibitive and the companies moved away.

In the 21 years previous to 1912, 3 miles of pipe, mostly 6 in., were laid. Since that time under municipal ownership, the 6-in. main on Main Street, which has gradually become again a good general business street, has been paralleled with a 12-in. main and reinforced with 8-in. lines on parallel streets. During a recent underwriters' test the hydrant pressure showed a drop of but 9 lb. with nine 2½-in. and one 4½-in. streams flowing, the final pressure being 83 lb. per square inch compared with about 10 lb. obtainable with like tests under the old condition. The reinforcement was easily accomplished simply by laying the 12-in. main along the 6-in. and cross-con-

necting into it at intervals of at least 300 ft. By doing this few service taps needed to be made into the feeder main, which is laid about 6 ft. from the 6-in. line and on the opposite side of the street from a 12-in. gas main to prevent careless plumbers from tapping the gas mains for water, a not infrequent occurrence in Council Bluffs in the past in streets where both service pipes lie close together.

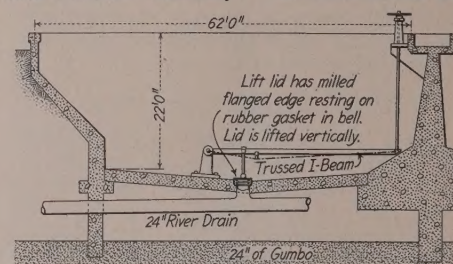
Simultaneous with the installation of the new pump an auxiliary 16-in. force main was laid to the city, tying in with a cross-line feeding the Union Pacific transfer yards, consumers of 500,000 gal. This enabled that railroad to scrap a 500,000-gal. softening plant built in 1902, taking water from Spoon Lake. It also relieved the main line to the business section so that three 6-in. mains could be extended to the Chicago & North Western yards and replace a 500,000-gal. softening plant for well water which the company was more than willing to abandon. In both of these cases quality as well as quantity was of importance. The supply under the old regime could rarely be delivered with a suspended matter of less than 100 parts per million, while this year for fifty-two days the turbidity of the river water averaged 7000 and that of the effluent after 24 hours' storage was always less than 25. The maximum turbidity was 12,000, 1.2 per cent.

To effect these turbidity reductions the three reservoirs, described in the Engineering Record Jan. 11, 1913, page 39, were constructed near the river. The old reservoirs, referred to in a description of the first hypochlorite of lime plant to operate in turbid water in this journal Sept. 17, 1910, page 334, could not be cleaned often enough to keep the mud from passing into the clear water basins because of the small area of the slough into which the mud was drawn off. No sewer to the river was available, and only after the surplus water drained away or evaporated could the basins again be cleaned. The recently installed 8,000,000-gal. receiving basin at the river accumulated 1 ft. of mud every day during the fifty-two days noted above. It was flushed out clean every week. Coagulant, 3½ grains per gallon, was added as the water passed in a sheet of 3-in. depth over a 45-ft. weir into basin 2. A special 6-in. concrete overhang on the incoming side prevents the mud from following up alongside the wall to the weir and a vertical under-baffle of galvanized iron forces the water to take a downward course. Entering basin 3 the water passes over a 50-ft. notch in the wall with the top 3 ft. under water, giving a velocity of 0.15 ft. per second so as not to break up any floc that remains. Most of the work done by the coagulant is accomplished in basin 2. In

basin 1 the mud is quite evenly distributed, being slightly deeper at the inlet end. In basin 2 the reserve takes place, as much as 7 ft. being found at the outlet end when a depth of but 5 ft. was noted at the inlet. This is due to the downward turn given to the water on entering. One-half the turbidity was removed in basin 1.

### PUMP EFFICIENCY UNIMPAIRED BY MUDDY WATER

The intake is placed on a cantilever frame 5 ft. above the river bed and about 40 ft. from the shore line. The former low-lift steam-driven plant was replaced when the reservoir was completed by two motor-driven centrifugal units, each capable of delivering 13,000,000 gal. daily under 40-ft. head. Although pumping this muddy water for 2½ years a recent test showed an overall efficiency of 73.6 per cent, which would indicate little wear or at least no wear that reduces efficiency. The motors had an



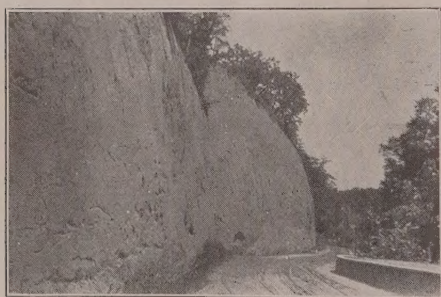
LEVER CONTROLS LIFT LID ON MUD DRAIN

original efficiency of 88 per cent and the pumps 83½ per cent.

The old reservoirs at the main station were lined originally with 2 ft. of gumbo and brick laid up dry. Every year frost and ice loosened up the lining and leaks started. These basins have all been relined over the gumbo with reinforced concrete 10 in. thick, the slabs being laid horizontally 4 ft. wide up and down the slopes. No expansion joints were used, except in the coping where ½-in. joints were placed at P. C.s and P. T.s at all corners and at 75-ft. intervals on tangents.

### CRAYFISH CAUSE BASIN LEAKS

A similar procedure was carried out on the Glendale storage reservoir located on the bluffs in the heart of the city. Here the trouble came each fall from crayfish which burrowed through the gumbo layer into the loess to get away from the cold water. Loess is a peculiar formation found only in the bluffs of the Missouri, on the Rhine and along the Yellow River in China. Cut vertically it has stood along the Fairmont Park road above the reservoir for over 30 years, while on the slopes it melts away like sugar. It is made of extremely finely-divided granite particles, cemented together so well that some of these vertical walls are sheer for 45 ft. Geologists claim the ridges are wind blown from South Dakota. In repairing the reservoir the area around the 16-in. riser pipe was apparently in good condition, but to take no chances the gumbo was excavated away and a cavern under it found fully 4 ft. across and 3 ft. deep where the loess had been washed away, through holes of the crayfish with which the cavern was literally alive. Some of the larger ones were 5 in. long. No trouble has been experienced with leaks since placing the 8 to 10-in. concrete lining. The crayfish have disappeared. The trouble with the crustaceans was anticipated by the superintendent when

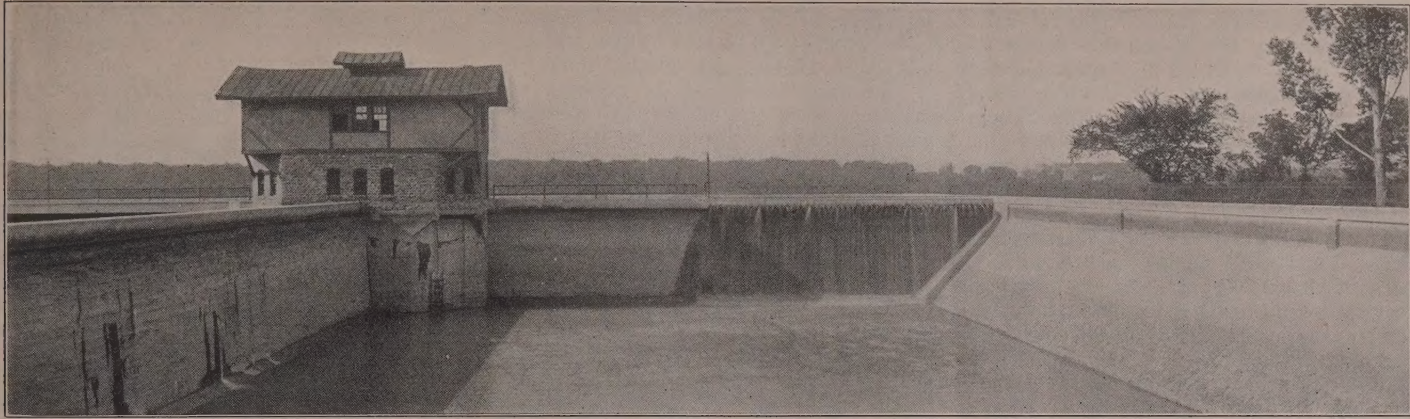


LOESS FORMATIONS HAVE STOOD FOR 30 YEARS WHEN CUT VERTICALLY

necting into it at intervals of at least 300 ft. By doing this few service taps needed to be made into the feeder main, which is laid about 6 ft. from the 6-in. line and on the opposite side of the street from a 12-in. gas main to prevent careless plumbers from tapping the gas mains for water, a not infrequent occurrence in Council Bluffs in the past in streets where both service pipes lie close together.

### PUMPING EQUIPMENT IN BAD SHAPE

The vital part of the system is the main pumping engine. When the present officials took over the plant two Knowles direct-acting pumps of 3,000,000-gal. daily capacity each were being worked to the limit. They were 30 years old, had a duty of about 40,000,000 ft. lb. per 1000 lb. of steam, and



WATER POURING INTO BASIN 2 BEHIND GALVANIZED-IRON UNDER-BAFFLE, WHICH FORCES IT TO TAKE A DOWNWARD COURSE

he learned of their existence, because some years previous in constructing an ice pond 8 ft. deep on the flats, he found so many crayfish holes that the entering water, after the pond was completed, ran away as fast as it came in. By plowing the bottom of the basin, disk harrowing and dragging to pulverize the gumbo the holes were filled. When water was again turned in none was lost and no further trouble was experienced with leaks. The crayfish were apparently drowned out.

#### DEVELOPING HIGH AREAS

In addition to these improvements the city has recently installed a high-service system consisting of two motor-driven multi-stage centrifugal units taking their supply from the riser feeding Glendale reservoir and forcing it through a 4400-ft. main to a 125,000-gal. steel stand pipe with the high-water level 401 ft. above the river. While the improvement cost \$30,000 and will furnish water for seventy families only at the present time, it will develop rapidly the most sitely portion of the city's area.

While all of these improvements have been carried out the department is living within its income of \$150,000 per year and not incurring any additional bonded indebtedness. Five-sixths of the taps are metered and the consumption, including 2,000,000

gal. daily used by the railroads, is 100 gal. per capita based on a population of 31,000. There are 600 families using wells and cisterns, but as fast as main extensions reach them the Health Department officials are using their influence to get city water installed.

In spite of the fact that the operating costs of the pumpage have been decreased 44 per cent (to \$21.85 per 1,000,000 gal.)

in the last 3 years, the salary of every employee has been raised. The Board of Water Commissioners is composed of three members, one of whom is appointed every two years by the mayor. While the council approves the choice they have no further authority over the board, which is headed by J. Chris Jensen, an architect and contractor. S. L. Etnyre is superintendent and has charge of all design and construction.

## Small Waterworks Revamped Under Service

Rapid Sand Filters and New Pumping Station Constructed at Painesville, Ohio, to Replace Lake Shore Infiltration Galleries

By G. W. KNIGHT and R. F. MacDOWELL  
Of Staff of R. Winthrop Pratt, Consulting Engineer, Cleveland

PAINESVILLE, OHIO, needed more water, a supply free from contamination and sufficient storage to equalize the draft. All of these improvements had to be built around, over and adjacent to the existing plant during its operation. The work was accomplished in 1914 without a shut-down longer than 3 hr.

#### BEACH GALLERIES UNSATISFACTORY

Painesville, a town of 5500 people, is located 30 miles east of Cleveland and 3 miles from Lake Erie. It has had a public water supply since 1889. Peculiarly constructed infiltration galleries consisting of wooden frames covered with a wire mesh and surrounded by gravel were placed just under the water surface at the beach line so that the wave action would keep the sand clear. For emergencies a direct intake extended 500 ft. into the lake but, as happens too often, the town got water much of the time through the emergency intake, which was near the mouth of Grand River, a stream carrying the sewage of Painesville and two other towns. The beach built up and the lake receded, thus decreasing the available water obtainable through the galleries. Additional galleries suffered a similar fate. Complaints brought investigators from the State Board of Health in 1910 and finally in 1913, through the Bense act, the city received a mandatory order to install filters.

Two 1,000,000-gal. horizontal, direct-acting, Knowles pumps forced water into the town mains from the circular brick well, 25 ft. deep and 30 ft. in diameter, and located on the beach 100 ft. from the pump house. Three 100-hp. boilers, a 60-ft. brick stack, brick station building and outlying frame structures for coal, stores, oil and tools completed a rather dilapidated plant.

Including the village of Fairport and Richmond the present daily water consumption averages 1,000,000 gal., but with an improved supply it was expected that the consumption would increase largely. Therefore the new plant was designed to supply 3,000,000 gal. per day.

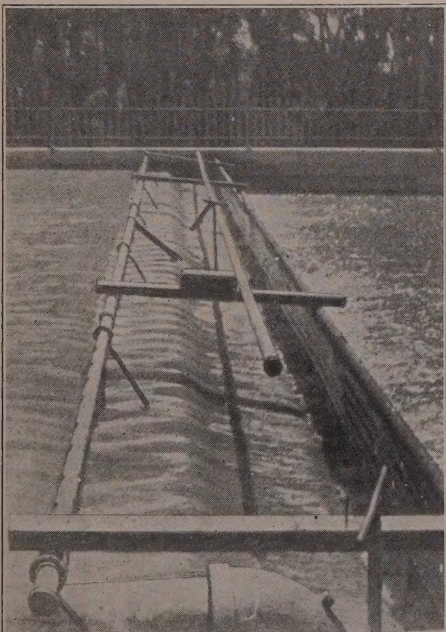
Considerations of economy in the preliminary design established the desirability of combining the proposed filter plant with such of the old station structure as would lend itself to a unit type of plant. It was accordingly recommended by the engineer that the new filtration plant be built as a unit with such of the old plant as should be salvageable, that all the operating features be placed under one roof and that such remodeling be done on the old station as would suit the needs of a new installation. The old pump house was accordingly converted into a low service pump room, where the turbine-driven centrifugal pumps could be operated, and the old boiler rooms and chimney space were converted into one large room to serve as the new high service pump room and main entrance.

Of the old outlying structures, none but the storehouse was worth saving and it was moved to a new location, there to serve during the period of construction as general storehouse and office for the contractor.

The improvement consists of an intake and crib, low service pumps, high service pumps, boilers, stack, filters and filter equipment, coagulation basins and a 100,000-gal. clear water basin.

#### LATTICED TIMBER CRIB INTAKE

The intake consists of 1500 ft. of 24-in. riveted steel pipe, imbedded in at least 3 ft. of sand, and terminating in a crib located in 21 ft. of water. The crib was



COAGULANT APPLIED THROUGH ORIFICES IN LONG PIPE OVER WEIR OUTLET OF BASIN 1

made up of two latticed timber frames, constructed of 4 x 12-in. timbers, drift-bolted together and placed one inside the other. The 6 ft. of annular space between the two frames was filled with one-man and two-man stone and the outside was ripped. On the intake end of the pipe, in the center of the crib, is a conical shaped screen containing a total of 590 1-in. round openings.

The two low service De Laval turbine-driven centrifugal pumps, each have a capacity of 3,000,000 gal. in 24 hr. The high service pumps consist of one new Canton-Hughes crank-and-flywheel, horizontal pumping engine of 3,000,000-gal. capacity, and one overhauled Knowles pump reassembled as a unit for emergency use.

Two 150-hp. Erie return-tubular boilers

tain 8 in. of selected beach gravel, overlaid with 34 in. of quartz sand having an effective size of 0.35 to 0.40 mm. and a uniformity coefficient not greater than 1.5.

The underdrain system consists of a manifold of special design with galvanized wrought-iron lateral pipes grouted in place on the flat floor of the filter. Hodgkinson strainers are secured into the laterals at intervals of 6 in.

Air is used for agitation through a manifold system placed immediately over the main strainer system, the laterals being perforated with 1/16-in. holes spaced on 6-in. centers. These holes are staggered with the strainers on the water pipe laterals.

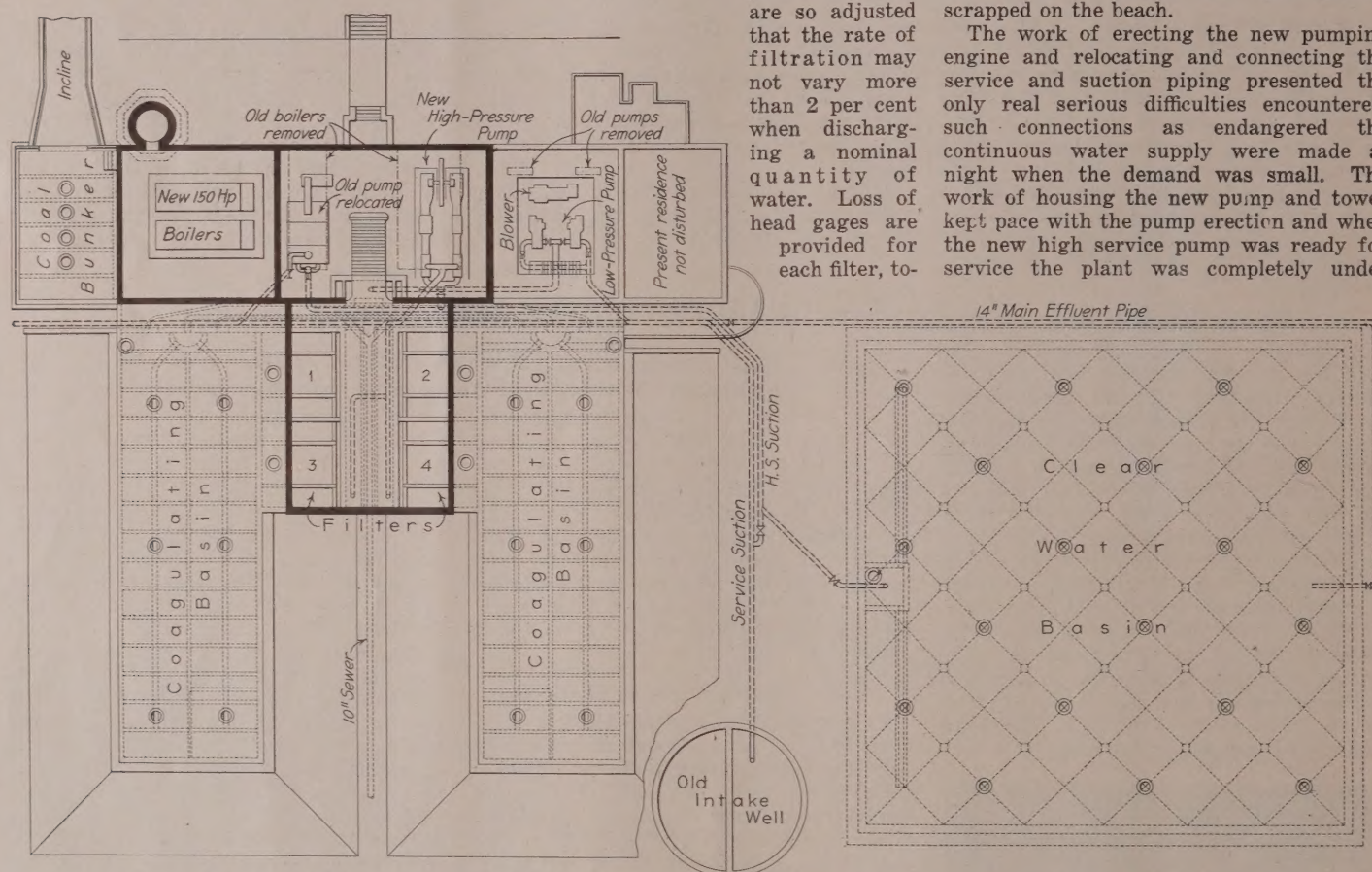
All valves are hydraulically operated. Rate controllers of the "Venturi" type are

provided, and are so adjusted that the rate of filtration may not vary more than 2 per cent when discharging a nominal quantity of water. Loss of head gages are provided for each filter, to-

possible before dismantling the old plant and to install all independent features, such as the clear-water reservoir, during the early period of the work of improvement. Accordingly work upon the coagulation basins, filters, coal bunkers, stack, boilers and boiler room housing was attacked simultaneously and carried well forward before any wrecking was attempted.

When the boilers, stack and coal bunkers were completed steam connections were made to the old pumps and the demolition of the old steam generating plant and housing was begun. The old stack was taken down piecemeal and the good brick found in the old stack and all boiler settings were cleaned and set aside for subsequent use in backing for new walls of the remodeled part of the old plant. The old boilers were removed intact and subsequently scrapped on the beach.

The work of erecting the new pumping engine and relocating and connecting the service and suction piping presented the only real serious difficulties encountered, such connections as endangered the continuous water supply were made at night when the demand was small. The work of housing the new pump and tower kept pace with the pump erection and when the new high service pump was ready for service the plant was completely under



PLAN OF WATER PURIFICATION PLANT AT PAINESVILLE, RECONSTRUCTED WITHOUT INTERRUPTING REGULAR SERVICE

are erected in the new extension to the pump building. They form a battery facing the new coal bunker, which latter was designed to carry five months' supply. A new Heine 100-ft. radial brick stack was also erected just south of the boiler room.

The two coagulating basins are each 28 x 90 ft. in plan and 16 ft. in average depth to the flow line, giving a 2.4-hr. retention period each when operating at full capacity. Each basin is divided into two parts by a concrete baffle wall running longitudinally through the center of the basin and across one end. The water enters the basin at the bottom of the end walls, and, after passing down one side and across the end, flows over a weir in the transverse baffle wall and thence returns to the inlet end. From this point it is conducted through a concrete flume to the pipe gallery between the filters. The equipment for one of the four 750,000-gal. filters has been omitted for the present. The filters con-

gether with an automatic signal bell and circuit, arranged so that the circuit may be closed at any desired loss of head.

Aluminum sulphate is used through 2-in. phosphor bronze and 1½-in. lead pipes to the points of discharge at either end of the coagulation tanks. Wash water is supplied from a wood stave tank of 12,000-gal. capacity located in the tower above the chemical solution tank room. The supply to the tank is replenished from the service main and controlled through operation of a balanced float valve. Pressure in washing the filters is adjusted to suit varying conditions, and the range is established between 1 and 10 lb.

#### MAINTAIN SERVICE DURING CONSTRUCTION

Considering the problem of construction from the point of non-interference with water service to the city, it was early decided by the engineers and the contractor to erect as much of the new work as

roof. After the initial tuning up, the new high service pump took its suction from the old intake well through temporary connections and by this service enabled the contractor to remodel the old pump room, remove the old pumps and install the new low service pumps and air blower. Simultaneously with the remodeling work in the old pump room the work of filter equipment, chemical feed equipment, wash-water tank erection and filter piping, including the flumes and drains, was proceeded with and factors in the filtering, pumping and storage of water were in shape to perform their functions.

The plant was designed in the office of R. Winthrop Pratt, consulting engineer Cleveland, Ohio, built by the Pitt Construction Company of Pittsburgh, and the work was carried on under the supervision of Mr. Pratt, with G. W. Knight in direct charge and R. E. Garvin as resident engineer.



HAULING WAS MOSTLY OVER SOFT ROADS AND THROUGH WOODS AND FIELDS

## Addition to Hartford Waterworks System Augments Daily Supply by 30,000,000 Gallons

Pipe Line, Tunnel and Conduit Through Exceptionally Rough Country Links 9,000,000,000-Gal. Reservoir with Existing System

BY MEANS of a 42-in. cast-iron pipe line, 36,660 ft. in length, 3667 ft. of concrete conduit and 2333 ft. of tunnel, already completed and in operation, the city of Hartford will link its new 9,000,000,000-gal. reservoir with its existing waterworks system at West Hartford, thereby making available, from a drainage area of 39 sq. miles, an additional daily yield of 30,000,000 gal. of water.

The reservoir is a natural basin, situated on high ground near the town of Collinsville. Two dams, one across the Nepaug River and another across Phelps Brook, which are the direct feeders, will impound the flow of these streams and complete the closure of the basin. Construction on both of these dams was started in the early summer of last year, and, at present, is well under way.

### CAST-IRON PIPE LINE

The cast-iron pipe line connects with the reservoir at the Phelps Brook dam and runs in a generally easterly direction across very rough country, and twice under the Farmington River, for a distance of 39,660 ft., discharging, at length, through a transition section into the concrete conduit. The big problem in connection with the pipe-line construction was the hauling and distributing of the pipes. The line, in general, ran perpendicular to the existing roadway, through wooded country and up and down very steep hills. The trucking was done by a sub-contractor who used two 3-ton and one 5-ton motor trucks and three horse-drawn trucks with four horses for each. It was the original intention to have the motor truck carry the pipe from the railroad to the points where the line intersected the established roadways, and log platforms were built at these points so that they could be unloaded from the motor truck and taken up by the horse-drawn trucks with a minimum expenditure of labor and a complete avoidance of delay to either. The motor trucks, however, showed up so well on a few tryouts, when they were driven over the soft meadow lands and the cleared passages through the woods, that they were used almost exclusively. The motor trucks generally carried the pipe all the way from the railroad tracks to the points along the line at which they belonged.

Although apparently a very simple propo-

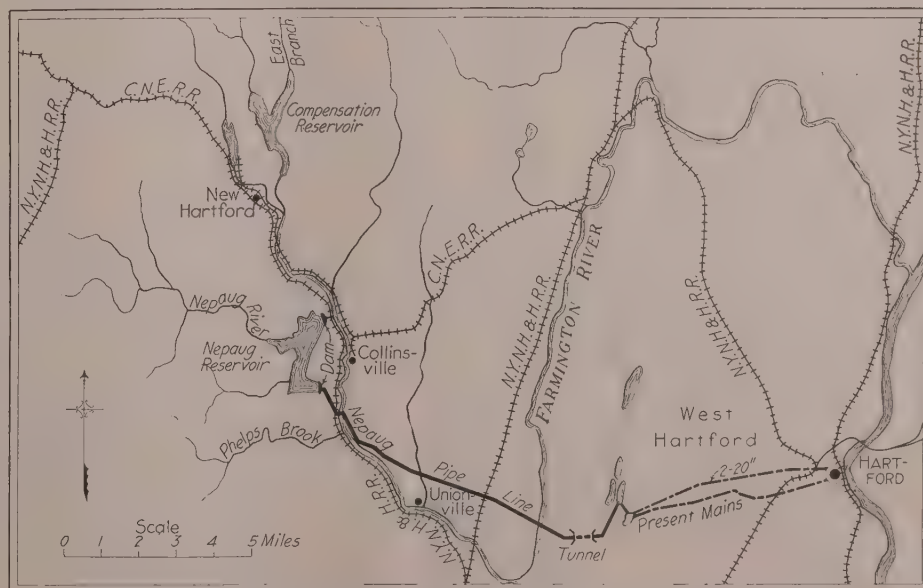
sition, the work of carrying the pipe line across the Farmington River at the two points where it intersected proved a very expensive and time-consuming operation. At the upper river crossing, near Burlington, the bed of the stream is composed of boulders, nigger-heads, smaller stone and gravel. As the pipe was to be laid at a bottom grade of about 8 ft. below the bed of the river, cofferdams were necessary for carrying on the work. It was considered inadvisable to attempt the driving of piles, so two parallel cribs of round logs, cut from a site near the work, were thrown out from the west bank to a point about 100 ft. into the stream and bulkheaded. These cribs were about 6 ft. wide and were spaced with an inside clearance of about 7 ft., then weighted down with stone. The guides for the sheeting were fastened on to these, a sheeting of 2-in. plank was set up ready for driving, and the interior of the dam was unwatered. A gang of excavators sufficient in number to cover the whole length of the trench, was put to work inside and, as the trench was sunk, the sheeting was driven down with mauls behind it. No difficulty was experienced until a depth of 3 ft. was reached. Then the diggers ran into a bed

of fine, running sand which greatly resembled quicksand in its action and proved very difficult to handle. As fast as the material was removed, new sand would rise up from the bottom and refill the space that was made.

### FIRST COFFERDAM WASHED OUT

Later developments showed that the flowing sand was caused by the weight of the cribs resting so close alongside, which pressed the material out under them and up into the trench. At first it was attempted to deal with this troublesome condition by keeping about 1 ft. of water on the bottom all the while, but, though successful to a certain degree, this method was soon abandoned, and the slow but certain method of keeping it weighted down with sand bags and digging over very small sections at a time adopted. By such means the trench was lowered to grade and made ready for the pipe. The bottom was not considered stable enough for a foundation for so heavy a pipe, so it was decided to stiffen it or to confine the sand. The river, however, after less than 24 hours of rain, rose to flood height and carried the cofferdam out.

By this time it was already late in the fall and, as the Farmington is a very uncertain stream during the winter months, no further work was done on the crossings until the following spring. Then, the upper crossing was attempted again in exactly the same manner as before, with the exception that the cribs were built wider, were more heavily weighted, and were spaced farther apart. The sheeting used in this dam was 4-in., tongued and grooved, and was driven by steam-hammers instead of by mauls. After very nearly six months of work, two sections of the crossing, each about 100 ft. in length, were completed. On the third, and remaining section, which was somewhat under 100 ft. in length it was decided to try a different method. Instead of parallel cribs, close alongside, it was decided to run the cribs off at an angle, on both sides, from the completed section so that, at the points where the shore was reached, the upstream crib would be about 70 ft. away from the trench and the downstream crib about 40 ft. away. This method proved entirely satisfactory. Once unwatered, the wider area was easily kept dry to as great a degree as was desira-



WATER FROM NEW RESERVOIR IS CARRIED TWICE UNDER FARMINGTON RIVER

ble and the sinking of the trench and the carrying on of the construction work was no more difficult than would have been the case had the work been carried out through similar conditions on dry land. For a foundation under the pipe at this crossing a floor of reinforced concrete was placed over the whole bottom between sheeting, and the sheeting was left in place up to the bottom of the river, with the walings also in place and cross-braced.

#### LOWER RIVER CROSSING

The work at the lower crossing, near Farmington, was a comparatively simple matter. The stream at this point is about 200 ft. in width and the upper stratum of the bed is of a stiff, self-sustaining clay. Two rows of piles were driven at this crossing on 8-ft. centers and about the same distance apart. The guides for the sheeting were bolted to these and the line carried across in two sections. A single row of 4-in. tongued and grooved sheeting, driven by steam hammer, was used for these cofferdams. Loose, running sand was encountered at this crossing also, but it was deeper down and not of so troublesome a nature, owing, doubtless, to the fact that there was no great weight on each side forcing it into the trench. A foundation, similar to the one at the upper crossing, was placed across the bottom at this crossing and the same height of sheeting was left in place.

#### CONCRETE CONDUIT

The concrete conduit was built in an open cut which reached a maximum depth of 30 ft. before suitable material for the tunnel headings was uncovered. The structure itself is horse-shoe shaped, 5 ft. high and 4.75 ft. in width, with a thickness at invert and arch, at its crown, of 6 in. Expansion joints were placed every 30 ft. and water stops of ingot iron, 6 in. wide by 5/16 in. thick, were embedded at the end of each section. The arch was built on collapsible steel forms and the outside was formed with ribs and wooden lagging. The concrete was mixed by a gasoline power mixer. Proportions were 1 to 6.

#### TUNNEL

The tunnel excavation was undertaken from each end and from a shaft sunk about 600 ft. east of the west portal. The material encountered consisted of sandstone for about 700 ft. and trap rock for the remainder. Considerable water was encountered, mostly from seepage and continuous dripping, but in several places considerable inflows came in through crevices in the rock.

As the inflow generally came from the entire length of the tunnel, it was found possible to put in the invert without an underdrain. The bottom was kept rather low and filled to subgrade with broken stone. Rather soft concrete was placed on this and worked into it. On top was placed, to the required depth, the invert masonry

of rather stiff mixture and kept about half an inch below finished grade. After this had had a chance to stiffen, it was floated with a finished coating wall compacted with wooden screeds and worked to a smooth finish. To keep water from the invert during construction permanent sand bag dams were placed upstream from the work and the inflowing water backed up and forced out through the conduit above. The concrete work was started from the shaft so that, by backing the water above out through the conduit, the concrete work on



CONDUIT FROM PIPE LINE TO TUNNEL

the invert proceeded downstream, forcing all water ahead.

Arch construction was first started on narrow lagging laid against ribs placed as near together as necessary to prevent bulging. The face of the concrete, however,

the tunnel and to a length of about 32 ft. Exploration of the deposit showed that it was undoubtedly a pot hole in the shale formed by a preglacial stream and subsequently filled with glacial detritus. On account of this condition it was necessary to timber the section heavily and the side walls of the tunnel were made thicker.

This work was done for the Board of Water Commissioners of the city of Hartford, for which Caleb M. Saville is chief engineer. The pipe line was constructed by the Hanover Contracting Company of New York City, and the conduit and tunnel by the Stobough Contracting Company of New York City. Work on the Nepaug dam is being done by Fred. T. Ley & Company of Springfield, Mass., and that on the Phelps Brook dam by the Pierson Engineering & Construction Company of Hartford, Conn.

### Marysville Filters Handle Excessively Turbid Water

By C. C. YOUNG

Director, [Water] and Sewage Laboratory, State Board of Health, Kansas

**D**URING the high water of June a most unprecedented burden was put upon the filter plants of Kansas. As extreme conditions of operation are always of interest to engineers I believe that the condition of the Blue River at Marysville, Kan. and the results of operation of the purification plant owned by the Marysville Light, Power & Water Company on the date of June 21, 1915, should be reported.

The plant was designed by Worley & Black, consulting engineers, Kansas City, Mo. There are two concrete filtering units, each of 110 sq. ft. area, designed to operate at 2 gal. per square foot per minute. Standard Pittsburgh filter equipment was used throughout in the construction of this plant. The two settling basins have a capacity of 63,000 gal. each and can be oper-

REPORT OF THE WATER AND SEWAGE LABORATORY OF THE STATE BOARD OF HEALTH, ON MARYSVILLE FILTER PLANT, JUNE 21, 1915

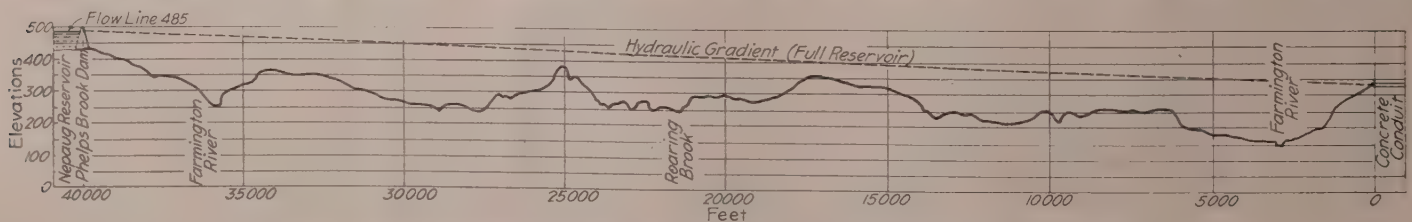
| Source          | Bacteria per cc. |         | Agar Gelatin |        | Lactose Peptone Bile |         |           |            |             | Alk. p. m. | Turb. silica p.p.m. | Suspended solids p.p.m. | Turb. coef. |
|-----------------|------------------|---------|--------------|--------|----------------------|---------|-----------|------------|-------------|------------|---------------------|-------------------------|-------------|
|                 | 37 deg.          | 20 deg. | 24 hr.       | 48 hr. | 1-10 cc.             | 5-1 cc. | 5-0.1 cc. | 5-0.01 cc. | 5-0.001 cc. |            |                     |                         |             |
| Raw Water       | 27,000           | Liq.    | +            | +      | 5+                   | 5+      | 5+        | 5+         | 5+          | 40.        | 75,000              | 98,000                  | 1.3         |
| Coag. & Settled | 350              | 1,000   | +            | +      | 3+2                  | 1+4     | 5+        | 5+         | 5+          | 4.         | 60                  |                         |             |
| Filtered        | 15               | 100     | +            | +      | 1+4                  | 5-      |           |            |             | 4.         | clear               |                         |             |
| Tap             | 13               | 80      | —            | —      | 5-                   |         |           |            |             | 4.         | clear               |                         |             |

was found to be quite rough, due to the spaces between the lagging, and also to the mortar running out and leaving voids. To obviate this the sections of lagging were covered with thin sheet iron with satisfactory results. Concrete was mixed in the proportion of 1 to 8 except in the key where a 1 to 6 mixture was used.

At one point in the tunnel the rock in the northerly side suddenly ended and instead there was found a pocket containing a mass of loose, coarse and well washed gravel. This pocket extended about half way across

ated in series, or parallel, as desired. At that time they were being used in series, and the coagulant was introduced at the raw water inlet and the outlet of the first basin. The total dose of 8 grains of aluminum sulphate per gallon was divided, 5 grains at the raw water inlet and 3 grains at the outlet of basin 1. As the alkalinity was reduced only 36 parts per million, it is evident that one-half of the chemical was absorbed by the mud.

The day these samples were taken 180,000 gal. of water were filtered in about 8 hr.,



PROFILE SHOWS GRADES FOLLOWED BY PIPE LINE FROM NEW RESERVOIR TO CONDUIT

thus allowing 6.3 hr. for the deposition of the mud in the basins. This condition of the river continued for 5 days and during the whole period the turbidity was less than 100 parts per million when delivered to the filters. The filtered water was clear and always contained some alkalinity. At one time it was necessary to dose 11 grains per gallon of aluminum sulphate with alkalinity of raw water less than 40 parts per million, yet 4 parts per million of alkalinity was the least amount recorded in the filtered water.

This plant has only been in operation since last November, and as this is the first bad water it has had to handle I think it is remarkable that it succeeded in removing this suspended matter at a rate of approximately 400 tons per million gallons.

THE FIRST WHOLE CARGO OF STEEL to be shipped through the Panama Canal in the United States coastwise trade passed through the canal, July 5, on board the steamship George Hawley from New York to San Francisco and Portland. The shipment amounted to 3849 tons.

## Rotary Screens Remove Macro-Organisms from Denver's Lake Water Supply

New Plant and 6 Miles of 48-Inch Wood Stave Pipe  
Increase Conduit Capacity to 400 Gallons per Capita Daily

FOUR cylindrical water screens, motor driven and water washed, were put in operation by the Denver Union Water Company at Marston Lake in July to remove algae, crustaceae, and larger vegetable growths from Marston Lake water. Avarice for water in Denver has been increasing so rapidly this season that the consumption touched the 75,000,000-gal. daily mark in July. The 48-in. wood stave pipe, 6 miles long, from Marston Lake to the distribution system, making any consumption over 65,000,000 gal. possible, has just been completed and enables the company to maintain the head in all the distributing reservoirs so that no complaints of low pressure are made in any part of the city.

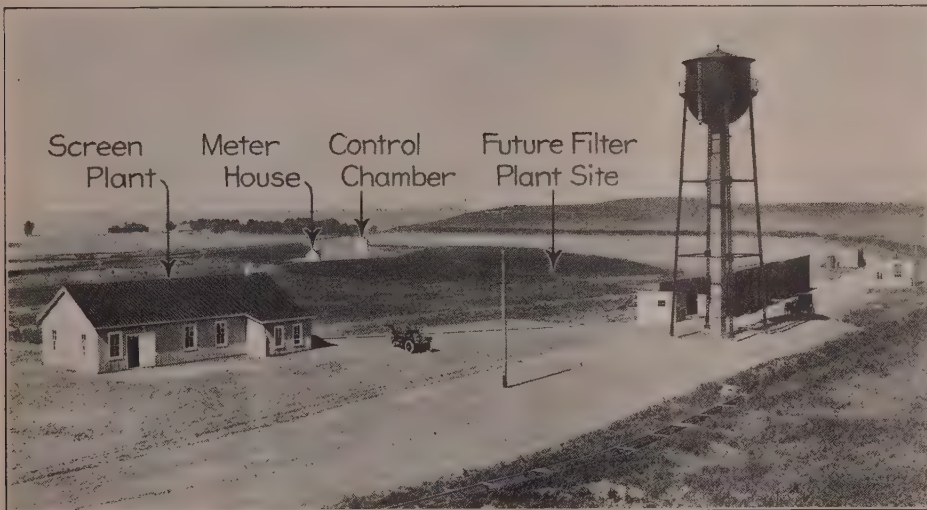
All waters entering the city are filtered or collected from underground galleries, but

for the supply to this conduit it was concluded to install the screening and sterilization plant, at least for the time being, as an additional supply. The removal of the crustaceans, larger forms of algae and "moss," mostly chara, is practically a necessary preliminary treatment for filters. Marston Lake has been the great distributing storage reservoir for Denver, for many years receiving water from Bear Creek during the non-irrigation season and from Lake Cheesman and the Platte River continually. From the south end through rapid filters 20,000,000 gal. are drawn and from the north end, nearest the city, it had always been the intention to lay a main to the city. In 1892 when the embankment at that point was raised to 40 ft. height an outlet tower was erected for future use and is now connected up to the screening and hypochlorite sterilization plant. The new conduit was briefly noted in the Engineering Record June 5, page 715.

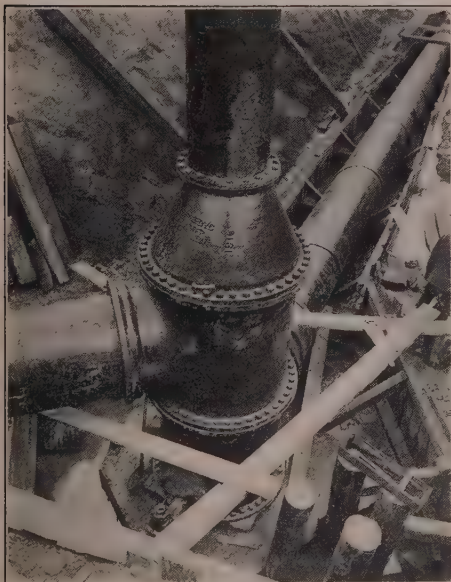
### SCREEN PLANT

Built to screen 20,000,000 gal. of water daily this unique installation, which is a partial adaptation of screens used in the paper mill industry, consists of a concrete basin 25 x 50 ft. in plan by 7 ft. deep. Longitudinal division walls near the center of the basin form four 5 x 14-ft. 9-in. compartments for the screens. At the inlet end a float-controlled 42-in. shutter valve maintains a constant head of water between this point and a controlling well at the head of the 48-in. conduit, 1800 ft. away. A screen of 1-in. mesh prevents fish from getting to the rotary screens.

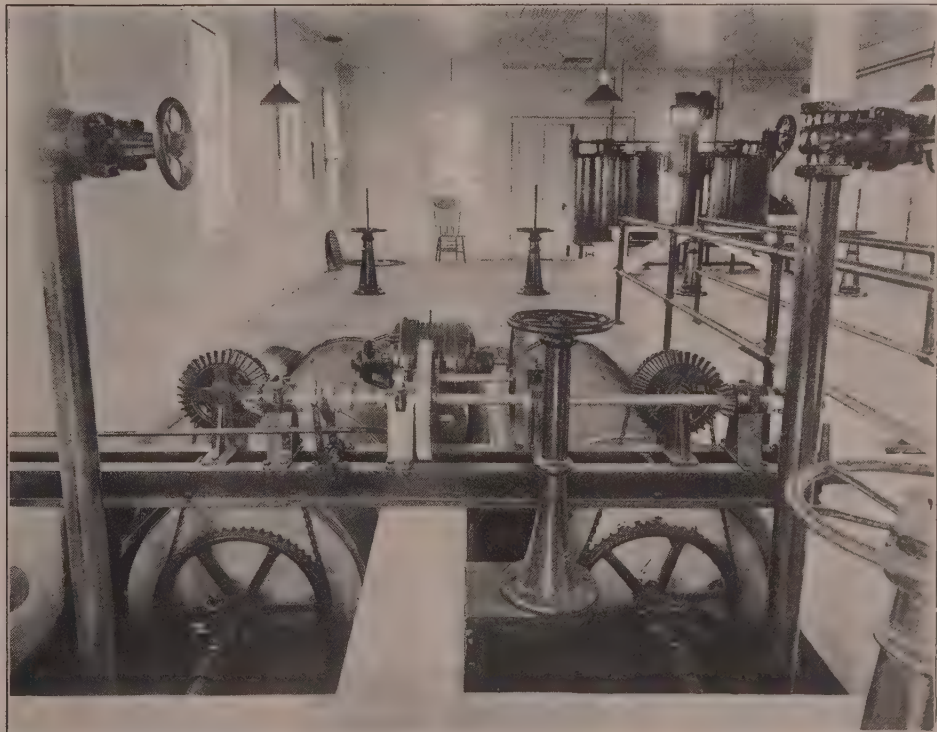
The rotary screens, each 10 ft. in length, consist of structural steel frames of six



GENERAL RELATIONSHIP OF STRUCTURES FOR  
SCREEN AND STERILIZATION PLANT  
AT MARSTON LAKE



COMBINED RISER AND ANGLE SPECIAL FOR  
CONNECTING STEEL AND CAST-IRON PIPE



TWO OF THE FOUR ROTARY SCREENS—WASH TROUGHS ARE AT LEFT AND HYPOCHLORITE  
PLANT IN FAR END OF ROOM

2 x 2 x 1/4-in. horizontal tees and six 1/2 x 2-in. bands of 42-in. diameter around which 40-mesh brass wire cloth is secured. The upstream end is bulkheaded and the lower end is open. Water enters outside the screen, passes through and out the end, about one-half of the surface only being submerged. A water-tight joint at the lower end is formed by a felt packing strip riding on a brass bearing band. By means of individual clutches one or all of the screens can be rotated by the 3-hp. motor. It is the intention to revolve the screens only for washing, but it is possible to gear down the motor and rotate the screens continually. A sterilization plant is located beyond the screens.

Wash-water enters the inside of the screen through the hollow bearing of the bulkheaded end. A 2-in. pipe perforated with 3/16-in. holes spaced on 3/4-in. centers is located close to the screen about 10 in. above the normal water surface. The orifices discharge through the screens into a longitudinal hooded trough. This feature enables the screens to be cleaned without removing the water from the compartment or stopping operation.

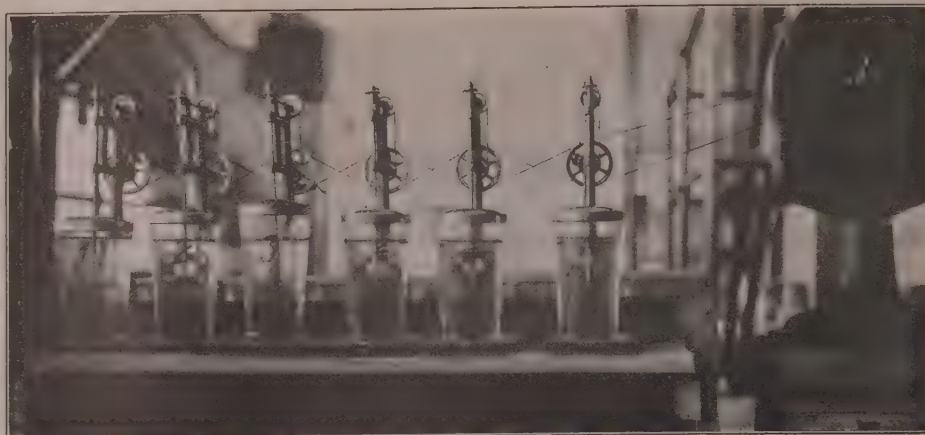
Although the screens are designed primarily to remove the relatively large vegetable forms like chara, some experiments with fine mesh sieves indicate that cyclops will pass through an 80-mesh screen and will be retained by a 100-mesh screen. One or two of the screens will be fitted with these fine screens while the amount of water passed through the plant is so much below the designed capacity. The loss of head, now practically nothing, would probably be too much to put through the entire 20,000,000 gal. daily, particularly when the "moss" is running.

Bacterial efficiencies obtained by the screen and sterilization plant follow:

| Date    | Lb. av. cl. used per million gal. | Bacteria per cc. after 48 hr. Raw | Treated | B. Coli in 10 cc. Raw | Treated |
|---------|-----------------------------------|-----------------------------------|---------|-----------------------|---------|
| July 13 | 2.54                              | 230                               | 13      | —                     | —       |
| 14      | 2.62                              | 500                               | 1       | —                     | —       |
| 17      | 2.57                              | 2000                              | 11      | +                     | —       |
| 21      | 2.58                              | 850                               | 16      | —                     | —       |
| 29      | 2.69                              | 650                               | 15      | —                     | —       |
| 31      | 2.42                              | 450                               | 11      | —                     | —       |
| Aug. 3  | 2.48                              | 300                               | 7       | +                     | —       |
| 4       | 2.44                              | 350                               | 14      | —                     | —       |

When the dike was raised in 1892 a tunnel was driven through the ridge out into the lake so that the future pipe could draw water from the lower levels. The outer end or intake was like a manhole and was sealed by a 300-lb. cover, 4 ft. in diameter with a lifting ring. The ring, made of 1-in. metal, was found rusted off and a diver from Chicago had to be summoned to raise the cover. He did this in a very few minutes by prying it off with a crowbar. The cover was under no pressure as water was pumped from the gate house into the conduit to equalize the pressure from the outside. The location of the intake, 1100 ft. from the gate house in the center of the dike, was so accurately determined by means of two transits set at the opposite ends of a base line that the diver landed on the intake the first time down.

All of the work was carried out for the Denver Union Water Company under the direction of D. G. Thomas, chief engineer. The Roberts Filter Company furnished the plans and built the screen and sterilization plant. The American Bridge Company erected the 20,000-gal. wash-water tank, and the work incidental to the pipe connections was done by company forces.



PADDLE-WHEEL CHURN MIXING MACHINE FOR LABORATORY TESTS

## Whipping Chemicals Into a Colloidal Water Increases Efficiency

Six Paddle-Wheel Churns and an Intricate Chemical Mixing Box Aid Kansas Engineers in Study of Proper Preliminary Treatment

COAGULATION experiments on the colloidal Neosho River water pumped to the rapid filter plant at Burlington, Kan., indicate that whipping the chemicals into the water materially reduces the amount necessary to obtain a satisfactory flocculation. Tests covering a month's time were made at this 1,000,000-gal. daily filter plant, built in 1913, to get specific data as to the proper preliminary treatment to give the water, which is subject to sudden and extreme turbidity changes. A reduction in cost of chemical was also sought. The Burlington plant was chosen because of the flexibility of the layout from an operating standpoint and because, in previous tests made by State Board of Health officials, the efficiency of the chemicals was shown to be very low, the reduction in alkalinity being only 2 parts per million per grain of alum fed instead of the theoretical value, 8.3 parts. This condition occurred at times when it could not be accounted for altogether by the turbidity content. The plant is manned by competent operators and these tests were not made as a result of poor work by the plant but to promote economy and efficiency.

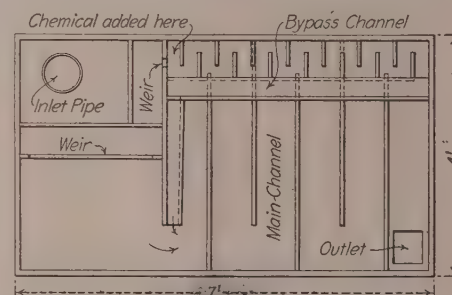
### DIFFICULT TO GET GOOD FLOC

The plant consists of two settling basins, 66 x 70 ft. in plan and 12 ft. in depth, operated in parallel; two coagulating basins holding 32,500 gal. each; and two gravity filter units 12 x 14 ft. in plan equipped by the New York Continental Jewell Filtration Company. The special feature is in the design of the mixing box and agitating chambers. The latter are 4 ft. deep, 3 ft. wide, and have concrete baffle-walls 18 in. apart, extending within 1 ft. of either wall. The rapid passage of the water by the baffles after the violent mixing in the agitation chambers usually resulted in an excellent floc before the water passed half way through the agitating chambers. The wash-water average has been 5.1 per cent of the total amount. On the average 1.23 grains per gallon of aluminum sulphate have been used, varying from 0.5 to 3.5 grains. However, Mr. Whistler, the superintendent, reports that at times it was difficult to get a good floc

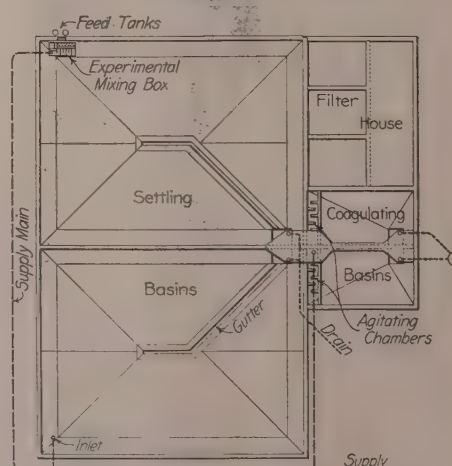
regardless of the amount of coagulant used. The tests indicated that this was probably due to the suspended clay cutting down the efficiency of the alum and to the high CO<sub>2</sub> content, characteristic of this water. Other than this difficulty with the alum the complete tests made in 1914 by the State Board of Health reported the plant to be in excellent condition.

### BUTTER CHURN AGITATOR

To solve any further difficulties extended tests were carried out in July and August of this year. For the laboratory tests a mixing machine, made up of six paddle-wheel churns, was arranged, as shown in one of the photographs, to be turned by one



DETAIL OF THE BAFFLED MIXING BOX



RAPID FILTER PLANT, SHOWING LOCATION OF EXPERIMENTAL MIXING BOX

belt from a water motor. Any paddle speed and any length of mixing period could be applied to six samples at one time.

For tests on chemicals in the basins a wooden mixing box, also shown in one of the photographs, was built to mix the chemicals thoroughly before reaching the settling basin. The box consists of an entrance well with a stilling box enclosed in it and outlets formed by Cippoletti weirs, a large baffled channel leading to the basin and a small baffled channel leading to the entrance to the main channel.

In using the box a portion of the water was by-passed through the small baffle chamber and treated with the entire dose of chemical, thus securing the extra time of mixing and also securing a more dilute solution of chemicals. It was the idea that the more dilute the form in which the chemicals were fed into the water, the more complete would be the reaction with the alkalinity in the water. The time of mix in the small channel was about 25 sec. and in the large channel it was about 20 sec. The velocity was 1.5 ft. per second in the small channel and 1 ft. per second in the large channel.

Turbidity readings were taken over the basins after tests with each system of coagulation, and charts were made showing the distribution of turbidity.

Any change in the level of the river was

on the basins. In the laboratory tests no advantage could be found in using the more expensive potash alum. The smaller amount of available alumina easily accounts for this fact.

It was found that on using sufficient amounts of alum, excellent results could be obtained in holding down the sediment in the basins, but the efficiency of the alum was low. At times of excessive turbidity it was difficult to get desired results. The cost of feeding large amounts of alum into the very turbid water was the thing that was desired to be overcome. The plan of feeding a large amount of alum at the entrance to the settling basins and then a minimum amount at the entrance to the coagulating basins was tried, but the results were not good. A reasonable amount of alum did not hold down the sediment in the settling basins, and the reduction in alkalinity showed plainly that much of the alum was not taking effect. In addition to this the relatively high amount of  $\text{CO}_2$  in the raw water is not beneficial to the quick forming of floc from alum.

Tests with lime and iron were run in the hope of forming a coagulant with a greater specific gravity than alum floc, and one which would go further toward holding the sediment down when being fed in small amounts. The system had the disadvantages of requiring two separate feeding devices and constant attention, as well as incurring the risk of corrosion of the filter strainers and incrusting of the sand grains in the filters. It was intended to feed a small amount of alum just before the water reached the filters to prevent as far as possible the latter action from taking place.

As in the case of the alum the lime and iron did good work when used in sufficient amounts, but to keep within a reasonable cost of chemical it would have been necessary to add such small quantities that practically no benefits would have been obtained.

In this test, however, it was noted that on adding lime in excess of the theoretical amounts, much better results were obtained. In fact the reduction in turbidity seemed to depend more on the excess of lime added than on the amount of ferrous sulphate used.

#### LIME ALONE EFFICIENT

Tests were run with plain lime treatment both on the basins and with the mixing machine. The results of the tests indicate, that for this particular water the plain lime treatment followed by a minimum dose of alum to form a floc and to form enough  $\text{CO}_2$  to decompose what carbonates had been bound, gives best results. In the settling basins it was found that, considering cost, the lime was as efficient as the alum, or lime and iron, in the removal of turbidity, and in addition left the water in better condition for the final addition of alum. Lime, however, would not remove color.

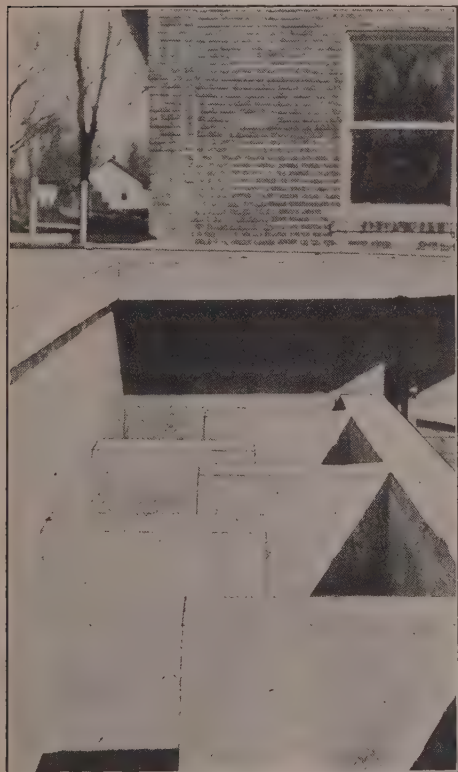
The bicarbonate alkalinity of the water would not be changed until the  $\text{CO}_2$  was used up, then it began to drop on the addition of more lime until it was completely removed. The carbonate alkalinity rose steadily until the saturation point, approximately 30 parts per million, is reached. In practice it was not unusual to find 40 to 50 parts per million carbonate showing a super-saturated condition. This was probably due to the formation of magnesium carbonate along with the calcium carbonate.

In the addition of alum the  $\text{CO}_2$  set free on the formation of the aluminum hydrate, reacted with the carbonates in the water to form bicarbonates, and the water going on to the filters was found to be devoid of  $\text{CO}_2$  and carbonates. The bicarbonate alkalinity was reduced from 15 to 20 parts per grain of alum added. In the presence of carbonate and in the absence of carbon dioxide the floc formed more quickly and more completely, thus the alum dose could be reduced materially.

One grain of alum at Burlington costs approximately the same as 2 grains of



APPLYING CHEMICAL TO SMALL BAFFLED CHAMBER OF MIXING BOX



CONCRETE BAFFLES IN AGITATING CHAMBER OF COAGULATING BASIN

quickly noticeable in the character of the water pumped. The water dealt with had the following average chemical content for factors most important for this test: Alkalinity, 76 to 224 parts per million—all bicarbonate,  $\text{CaCO}_3$ ;  $\text{CO}_2$ , 6 to 8 parts per million. The calcium content was approximately five times the magnesium content.

#### ALUM AND LIME AND IRON EXPENSIVE

Potash alum and aluminum sulphate were used in tests with the mixing machine, but aluminum sulphate only was used on tests

lime, which will allow this treatment to be used generally at the same cost as alum alone. The results will be better in that (1) the  $\text{CO}_2$  will be removed; (2) the water will be partially softened; (3) the danger from incrusting the sand grains will be avoided as all the carbonate is removed before the water enters the filters.

The general significance of the results obtained, as set forth by the engineers making the tests, is that it is possible by the use of lime to prepare a similar colloidal water for treatment with alum, so that the amount of alum necessary is small, and the total chemical cost is much less than when alum alone is used. The lime itself does not remove the colloidal condition in the water, but it prepares the water so that the only duty for the alum to perform is to remove the colloidal condition, the color and to form the necessary floc for proper filtering.

The tests were made by Black & Veatch, consulting engineers, of Kansas City, designers and builders of the plant.

THE EARTH WORK DIAGRAMS mentioned under "New Publications" in last week's issue were prepared by C. A. James, resident engineer of the Lehigh Valley Railroad at Buffalo, and not by C. A. Jones, as stated in the announcement.

## California Oil Pipe Line, 200 Miles Long, Built in Record Time of 15 Months

Route Crossed Mountainous Country at Great Altitudes—Pipe-Screwing Machine Aids Rapid Progress—Sixteen Pumping Stations Installed

**B**REAKING all California records for speed of construction, an oil-carrying pipe line 8 in. in diameter and 150 miles long, with a 54-mile branch, to Mojave, has been built in 15 months from the oil fields of the San Joaquin Valley to San Pedro, the newly completed seaport of Los Angeles. The conduit reaches altitudes never before attained by lines carrying heated California oils and is served by sixteen pumping stations, the larger ones having a capacity of 1000 bbl. of oil per hour against a pressure of 800 lb. per square inch. Twenty-five miles of the line crosses mountainous country, where heavy snow impeded progress. Water was scarce in the dry season and roads had to be built to deliver materials to the work from railroad stations 60 miles distant. Added to these troubles of a purely construction nature was the difficult task of obtaining right-of-way franchises in the vicinity of Los Angeles and San Pedro. Oil pipe lines in California now occupy a conspicuous place on account of the recently enacted laws clothing them with all the duties and responsibilities of common carriers. The line described in this article is owned by the General Pipe Line Company, and while not the largest line in the State, is one of the most important.

The line was not built as a custom line or a common carrier, but to carry the oil of the General Petroleum Company to a seaboard and market. If required, it will have to comply with the conditions the new laws impose and accept other producers' oil for transport under such rates and rules as may be approved by the Railroad Commission of California.

The General Petroleum Company and its early subsidiaries had been acquiring and developing oil lands in the Midway, Sunset, Belridge, and Lost Hills oil fields, and was rapidly coming to the front as an oil producer. In 1911 it found that when the development work then under way was completed it would be producing probably more than 15,000 bbl. of crude oil daily and that steps should be taken to provide independent means of oil delivery from fields to market.

San Pedro had just been annexed to Los Angeles and was attaining prominence because of the probable favorable influence of the Panama Canal, the excellent railway facilities, the expenditure of millions of dollars by the U. S. Government for a breakwater, and the construction of wharves by the city of Los Angeles and private in-



ROUTE OF OIL PIPE LINE AND LOCATION OF PUMPING STATIONS

terests. A pipe line terminating at San Pedro would open up to the company the markets of the Orient, Alaska, Puget Sound, Columbia River, San Francisco, Mexico, and the west coast of South America, and upon the completion of the Panama Canal the markets of Europe and east coast of North and South America would give new opportunities.

In addition, there are large manufacturing industries and electric power stations around Los Angeles, with an active growing local market accustomed to the use of oil fuel supplied partly from other parts of California and partly by several small local oil fields, some of which were apparently approaching exhaustion.

### SURVEYS OF ROUTE MADE

Reconnaissance surveys, therefore, were made to determine the feasibility of a pipe line route from the oil fields to San Pedro. A line was finally located through the Tejon Pass, which lies 16 to 20 miles east of a direct line, and which crosses two summits, one of 4222 ft. and the other of 2716 ft. The line, as located, ascends the Tenyo Creek from the San Joaquin Valley to Tejon Pass, El. 4222, descending the valley of Piru Creek and then boldly crossing the divide, El. 3716, between Piru Creek and Castiac Creek, and following Castiac Creek to Sangus, from which point the main highway was followed to Los Angeles. At the summit in San Fernando Pass a short tunnel was used. Through the city of Los Angeles a right-of-way was obtained on the property of the Atchison, Topeka & Santa Fé Railway, and after considerable difficulty and expense franchises were obtained permitting the laying of pipe alongside the county roads in Los Angeles County and through San Pedro, a part of Los Angeles City. Careful study indicated that with pumping stations properly located, a pipe line could be satisfactorily operated over the route laid out.

The final located line commences at North Midway pumping station in the north end of the Midway oil-field and runs southwest through the Midway and Sunset oil-fields to Pentland, thence east to the Tenyo Creek and over the line previously described to Los Angeles and San Pedro. It is 152 miles long and laid with 8-in. pipe. A 54-mile 8-in. branch line runs from Lebec pumping station to Mojave for the purpose of delivering oil to the Atchison, Topeka & Santa Fé Railway for locomotive fuel and for shipment to points in Arizona and New Mexico, by this means avoiding the expensive railroad haul from Bakersfield up the Tehachapi heavy grade and over Tehachapi Pass to Mojave.

### PIPE LINE CONSTRUCTION

The pipe used on the main line is standard lap-welded, open-hearth steel, weighing 29.213 lb. per foot. The steel has



PIPE CROSSES ALAMOS CREEK ON SUSPENSION BRIDGE



ONE OF THE SIXTEEN OIL PUMPING STATIONS



TWENTY MULES AND SPECIAL EQUIPMENT OF TWO WAGONS WERE REQUIRED TO DELIVER BOILERS TO PUMPING STATIONS

a tensile strength of 45,000 to 55,000 lb. per square inch. The branch line from Lebec to Mojave was laid of similar pipe, made, however, of Bessemer skelp.

The pipe received two coats of California asphaltic paint and was covered with a high grade roofing paper secured in place with wire. The average trench depth was 32 in., but in cities the trenches were made 40 in. deep. Through irregular country where many draws and ravines are encountered small trestles were installed and the pipe provided with an extra covering for mechanical protection. At some stream crossings the pipe was supported on the existing bridges. At other streams with intermittent flow where no bridges existed or permission to use existing bridges could not be obtained, a row of piles was driven, cut off below the surface of the gravel wash, and the pipe laid in a trench 4 ft. deep dug on the upstream side of the line of piles. The pipe was then surrounded by a concrete casing 22 in. square, and bolted to each pile with long stirrup bolts.

An existing highway tunnel was utilized at San Fernando Pass to reduce the summit elevation and save distance, and another short tunnel was driven to avoid a slide.

#### SIXTEEN PUMPING STATIONS

There are sixteen pumping stations, of which fourteen are on the main line and two on the Mojave branch. Eleven stations are standard main line pumping stations, and are capable of pumping about 1000

bbl. of oil per hour at 800 lb. per square inch pressure. The remainder of the stations are fitted for special duties, such as serving refineries, loading tank cars, ships, etc.

Each main line pumping station is designed to deliver oil through a section of the pipe line, which is long or short, depending on the degree the grade of the pipe line retards the flow of the oil. The sections vary from 6 miles, ascending the mountains, to 21 miles, descending.

At least one 37,000-bbl. tank is installed at each station, which when kept full, provides for 18 hr. operation of the pumps in the event of repairs being undertaken on the pipe line back of that point. Water is stored in a 500-bbl. tank, and two 100-bbl. tanks are used to store and measure the oil taken for fuel purposes.

The high duty pumping unit consists of a 26 and 42 x 36-in. cross-compound Corliss engine manufactured by the Allis-Chalmers Manufacturing Company, connected by a Scotch yoke to a special design 6½ x 36-in. four-plunger oil line pump, manufactured by the Dow Pump & Diesel Engine Company. The reserve unit is a duplex compound direct-acting 22 and 38-in. 9½ x 36-in. oil line pump, manufactured by the Jeanesville Iron Works.

The oil ends of both units are identical except as to diameter of the plungers; the interchangeability of cylinders, valves, valve fittings, discharge piping and other parts, necessitates only a small stock of spare parts. All cylinders, valve fittings

and discharge piping are made of cast steel and were shop tested at 2000 lb. per square inch. The machinery was all erected by company engineers, many of whom were later made operating engineers.

The pipe line is continuous past the stations, which may be by-passed if desired. Normally a branch line leading to the storage tank is used. The oil delivered into the station tank is drawn out again from any level by means of a swing pipe and after being conducted through two heaters to the pumps, is forced through the next section of the line. A branch line is provided so that the oil can be conducted directly to the heaters and pumping station without entering the tank.

Each station consists of a 54 x 100-ft. steel frame building covered with corrugated iron, containing the boilers and pumping machinery. In the engine room are two large pumping engines, one being an economical high-duty, cross-compound crank-and-flywheel pumping unit, and the other a direct acting duplex compound unit. Normally the first unit is operated and the second unit reserved for emergency service, but either can operate the line to full capacity. The exhaust steam from the main pumping engines is conducted to heaters and raises the temperature of the oil sufficiently to increase its velocity to the required degree by increasing the fluidity of the oil.

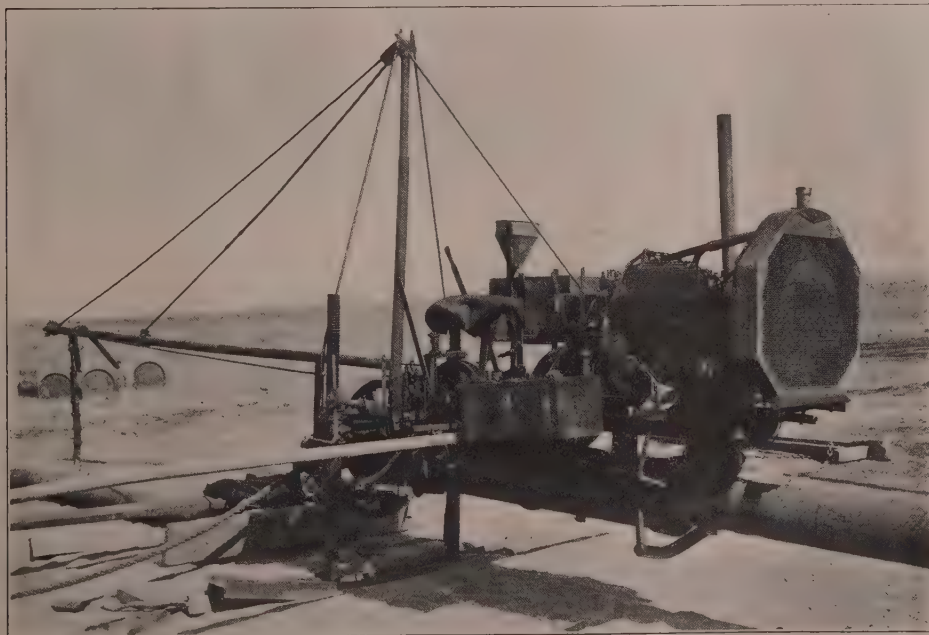
#### CONSTRUCTION DIFFICULTIES

The construction of the line presented many difficulties due to rough country, absence of roads, sandy soil, scarcity of water, and hot summer climate. Practically all supplies needed were brought in by mule teams from the railroad—lumber, brick, food, camp equipment, cement, feed for stock, and gasoline for auto trucks. A contractor was engaged to do the hauling and pipe laying. On the main line work he started hauling with auto trucks, which quickly cut the unsurfaced roads so as to make their further use impracticable. Nearly all of the hauling had to be done by mule teams, over 600 animals being used for several months. On the Mojave branch line, motor trucks were successfully used as this work was done almost wholly during the summer season.

As far as possible trenching machines were used to dig the ditch for the pipe, and on the long desert stretches very rapid progress was made. Hand work was necessary only in the mountainous part of the line.

#### MACHINE SCREWS PIPE SECTIONS

A very ingenious pipe-screwing machine was developed by the contractors, and consisted of a frame supporting a 40-hp. four-cylinder automobile engine, which rotated



AN INGENIOUS MACHINE, INVOLVING A FOUR-CYLINDER AUTOMOBILE ENGINE, SCREWS JOINTS OF 6000 FEET OF PIPE DAILY

a pipe gripping chuck, in some respects similar to the chuck of a pipe machine. The whole machine, as shown in one of the illustrations, was mounted on rollers resting on the pipe along which it was moved by power from coupling to coupling of the pipe line as the pipe screwing progressed. The finished pipe was supported on skids laid across the pipe trench until coated. A friction drive in the transmission mechanism between the engine and the clutch insured against screwing the pipe too tight. Each machine when well handled was capable of screwing daily an average of about 6000 ft. of 8-in. pipe.

Fifteen months elapsed from the date of commencing work to the delivery of oil at San Pedro, which is a record performance on California pipe line construction. The right-of-way and pipe laying operations were handled by R. E. Maynard. David Dorward, Jr., mechanical engineer, had charge of all pumping stations and their equipment. Sanderson & Porter were the consulting engineers and members of the advisory committee of the interests that financed the project.

### St. Louis Does Not Need to Increase Its Water Rates

ALTHOUGH the water consumer in St. Louis has paid \$92.73 per 1,000,000 gal. for water that has cost \$103.37 for the last eleven years, E. E. Wall, water commissioner, in his annual report, estimates that the decreased expenditures required for the next seven years will be sufficient to more than make up any deficit. Each year for the last eleven years the expenditures exceeded the collections by \$98,227.72, the loss being made up from accumulated surplus. This is the period during which purification has been a factor of expense in supplying water to the city. Heavy construction expense will decrease and an average of only \$888,902 for new construction, including interest and sinking fund, will be required, an average decrease of \$332,133.53 per year. This will reduce the average cost of supplying water by \$12.59 per 1,000,000 gal. below the \$103.37 cost during the last eleven years, and produce a revenue of \$1.95 in excess of the past cost.

### San Diego Has Second Largest Pressure-Type Filter Plant

SAN DIEGO'S filter plant is the second largest of the pressure type in existence, having a capacity of 10,000,000 gal. daily. The twenty filters are of the horizontal Continental Jewell type. Ten of the twenty filters are new and the remainder have been rebuilt from existing filters removed from Chollas Heights to the Lower Otay reservoir, according to H. A. Whitney, hydraulic engineer, as stated in his latest annual report. An air wash and hydraulic valves have been installed in the new plant and the wash-water is pumped back into the storage reservoir.

PERMITS TO USE WATER FOR IRRIGATION or Power in Oregon are summarized in a report recently issued by the State Engineer's office. In the last quarter 196 permits were issued which involved the construction of a total of 248 miles of canal, the irrigation of 21,164 acres of land and the development of 4254 hp.

## Concrete Cut from Actual Structures Stronger than Field-Sample Specimens

Relatively Low Averages for Many Test Cylinders Poured on Subway Construction Work Reported by R. E. Goodwin

CONTINUOUS testing of field samples is being carried out on the New York subway construction work by the materials testing laboratory of the Public Service Commission of the First District, New York. Regular standard methods have been adopted and put into practice in the testing of the aggregates and of the field samples poured on the work, and laboratory specimens made for comparisons. Results based on about 800 test cylinders have been averaged, and figures are given for 1:2:4 concrete at the ages of 28 and 90 days, classified in terms of various aggregates, both coarse and fine, of the consistency, and of machine versus hand mix-

batches of concrete other test specimens were cast in molds of the same size and some were stored in moist sand on the work, others in the moist room. In addition, samples of the cement and aggregates were taken to the laboratory and similar specimens were there mixed in the same proportions used in the field. These specimens were all tested at the age of 90 days. Those that were made on the work were machine mixed, and those made in the laboratory were hand mixed. The average weights in pounds per cubic foot were: Concrete cut from structure, 147; concrete from the same batch cast in molds, 150, and concrete made in laboratory from the same materials, 151.

### RESULTS FOR CYLINDERS

Table 1 gives the averages of the results to date for the compression tests on standard cylinders of concrete poured on the work, and includes only the tests made under satisfactory conditions in accordance with standard practice. In general, each test is the average of three specimens, and the result of any test which differed more than 50 per cent from the average was excluded. The averages including erratic values were slightly in excess of the averages given.

Since a large number of variables existed to affect the strength of each test, and no series was run in which only a single factor was the controlling variable, the averages shown for different conditions are not conclusive, but are at least suggestive. It is apparent from this large series of results that at the age of 28 days standard cylinders of field concrete averaged only about 1500 lb. per square inch compressive strength. The relative values for coarse and fine aggregates are given in the order of strength, Hudson River limestone and the washed gravel giving the same low values, and sand excavated on the work rating lower than the Long Island sand. The low values for very wet and extra wet consistency should be noted. The results for the relatively small number of hand-mixed specimens average 10 per cent below the machine-mixed values. However, the variations above mentioned make relative percentages of little value. The increase of the general average at 90 days over that at 28 days is 18.5 per cent.

### EFFECTS OF FROST

The above averages include specimens made in cold weather. With the exception of specimens which were frozen, these were found to be as strong as specimens made in warm weather. Specimens which showed frost marks in the interior when broken averaged 730 lb. per square inch at 28 days (ten tests) and 1170 lb. per square inch at 90 days (ten tests). These frozen specimens are not included in the averages given.

Investigations were made to determine what relation exists between strength and weight per cubic foot. Specimens of different aggregates showed no general increase of strength with weight, and it seems impossible to predict the strength

TABLE 1—TESTS OF 1:2:4 FIELD CONCRETE IN 8x16-INCH CYLINDERS MADE BY N. Y. PUBLIC SERVICE COMMISSION, FIRST DISTRICT

(The same tests are shown tabulated under different headings to show the effect of various conditions. There were three specimens in each test.)

|                                                                        | 20 DAYS OLD              |                                     | 90 DAYS OLD              |                                     |
|------------------------------------------------------------------------|--------------------------|-------------------------------------|--------------------------|-------------------------------------|
|                                                                        | Average, lb. per sq. in. | No. of tests represented in average | Average, lb. per sq. in. | No. of tests represented in average |
| Average of all tests.....                                              | 1560                     | 149                                 | 1850                     | 119                                 |
| <i>Coarse Aggregate</i>                                                |                          |                                     |                          |                                     |
| Hudson River dolomite.....                                             | 1760                     | 8                                   | 1980                     | 8                                   |
| Long Island beach gravel.....                                          | 1650                     | 33                                  | 2040                     | 24                                  |
| Hudson River trap rock.....                                            | 1570                     | 27                                  | 1910                     | 23                                  |
| Hudson River limestone.....                                            | 1490                     | 5                                   | 1830                     | 5                                   |
| Long Island bank gravel (washed)...                                    | 1490                     | 72                                  | 1810                     | 60                                  |
| <i>Fine Aggregate</i>                                                  |                          |                                     |                          |                                     |
| Long Island beach sand.....                                            | 1710                     | 39                                  | 2040                     | 27                                  |
| Long Island bank sand (washed)...                                      | 1590                     | 76                                  | 1850                     | 64                                  |
| Sand excavated on the work.....                                        | 1370                     | 27                                  | 1790                     | 25                                  |
| <i>Consistency</i>                                                     |                          |                                     |                          |                                     |
| Medium.....                                                            | 2670                     | 1                                   | .....                    | .....                               |
| Wet (stiff enough to keep coarse aggregate from settling to bottom)... | 1880                     | 60                                  | 2100                     | 52                                  |
| Very wet (coarse aggregate settles to bottom).....                     | 1470                     | 82                                  | 1790                     | 63                                  |
| Extra wet (soupy).....                                                 | 1200                     | 11                                  | 1520                     | 8                                   |
| <i>Mixer</i>                                                           |                          |                                     |                          |                                     |
| Machine.....                                                           | 1590                     | 124                                 | 1880                     | 104                                 |
| Hand.....                                                              | 1450                     | 19                                  | 1790                     | 16                                  |

ing. It is noteworthy that the average value for these standard 8 x 16-in. cylinders at the age of one month is only about 1500 lb. per square inch.

In addition, field samples have been cut from the actual structures, dressed and tested. The results exceed the values for the same concrete poured in cylinders, apparently confirming the claim sometimes made that concrete in the structure is stronger than concrete in the form of test specimens.

### SPECIMENS AND TESTS

The regular standard 8 x 16-in. cylinders were poured from the concrete going into the work, sometimes even being taken from the concrete in the forms. A simple form of mold was made by splitting an ordinary 8-in. iron pipe longitudinally on one side (to allow removal after the concrete had set) and using two iron bands with bent ends and bolts for tightening. The specimens were left two days on the job, then stored in the moist room and sprinkled every few days.

The specimens cut from the structure were finished to 6 x 6 x 12-in. dimensions on the rubbing table of a stone-cutting yard. They were cut out when the structure was two months old from designated parts, selected before the concrete had been placed in the forms. From the same

from the weight. Even among specimens of the same materials, the heaviest was the strongest in not more than 50 per cent of twenty-five tests examined.

#### FIELD-CUT CONCRETE STRONGER

Table 2 gives the results of the test of 1:2:4 standard cement, sand and gravel concrete specimens 6 x 6 x 12 in. in size tested at the age of 90 days. The curing conditions are given, and the results are seen to average considerably higher for the concrete cut from the structures than for the test specimens—8 per cent higher than specimens of the same concrete stored in moist sand on the work and 26 per cent higher than those stored in the moist room, while 30 per cent and 40 per cent higher respectively than laboratory specimens stored similarly.

The head of concrete above the specimens

## Frost 16 Feet Deep Found Under Refrigerator Plant

Continuous Operation of Refrigerating Machines for 19 Years Lowered the Frost Line Many Feet and Caused Floor Upheaval

By J. NORMAN JENSEN  
Architectural Engineer, Chicago

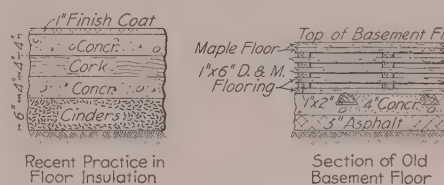
**SOME REMARKABLE RESULTS OF** Continuous refrigeration and frost action have recently been brought to the attention of the writer or revealed during investigations into the causes of noticeable upheavals of building floors. The most unusual case occurred in a refrigerator plant in which the apparatus had been in operation for about nineteen years. At one footing near large coils of ammonia pipes the depth of frozen earth was found to be 16 ft., while a frost depth of 7 or 8 ft.

floor consisted of a number of layers of flooring with strips between, and a concrete and asphalt sub-base.

#### RESULTS OF INVESTIGATION

The earth beneath the old basement floor was thoroughly frozen, and filled with small ice crystals. It was decided that the upward movement of the post could only have been caused by the heaving of the frozen ground underneath the footing. Orders were issued that new footings would have to be put in beneath the frost line under each post.

Excavating for these new footings showed that the frost line was anywhere



PROGRESS IN FLOOR INSULATION PRACTICE

from 1 to 16 ft. below the bottom of the old basement floor. The extreme depth of 16 ft. was encountered under a post which was alongside a partition in the basement.

The basement was partitioned off into a number of small rooms, in which were stored butter, eggs, apples, and other commodities. The temperature in these rooms varied with contents, but was only about 15 deg. Fahr. at the time of the investigation. A search was made for the cause of the great depth of frost encountered, and it was learned that immediately above the footing where the greatest depth occurred were especially large coils of ammonia pipes, so that the temperature at this point was much lower than anywhere else. It was also learned that there had been an old well about 7 ft. deep adjoining this footing.

#### EFFECTS ON WALLS

As a result of the unequal frost action underneath the wall footing, the walls had been heaved more in the middle than at the ends, and were badly cracked. They had to be anchored and thoroughly tied to prevent them from falling into the street.

It seemed strange that the earth should be frozen even 7 or 8 ft. as commonly found throughout this investigation. The temperatures had never been extremely low, as even in the coldest weather it had never been below zero in the rooms. This frozen condition of the ground, winter and summer, could only be accounted for by the fact that the refrigerating machines providing the low temperature in the store rooms had been in continuous operation for nineteen years.

In conclusion, it is of interest to note recent practice in the insulation of the basement floors of refrigeration plants. The bad design used in the old basement floor represents too big an inroad on the coal pile of this plant. The left figure of the accompanying diagram gives the practice of architect B. H. Jillson of Chicago. This detail has been used in the construction of a number of cold storage plants throughout the country.

THE FIRST STEEL RAILS FOR ALASKA'S new Government railway are en route to Anchorage, Alaska, where they will be used in the construction of yard tracks.

TABLE 2—COMPRESSION TESTS OF CONCRETE CUT FROM ACTUAL STRUCTURES AND CONCRETE CAST IN MOLDS  
(Size of specimens 6x6x12 in.; 1:2:4 concrete, 90 days old; all strengths in pounds per square inch)

| Cut from 12-in. wall                                                                                                                                                     | Same batch poured in molds and stored on work | Same batch poured in molds and stored in moist-room | Consistency | Same materials mixed in laboratory and stored on the work | Same materials mixed in laboratory and stored in moist-room | Consistency | Fine aggregate               | Coarse aggregate               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-----------------------------------------------------|-------------|-----------------------------------------------------------|-------------------------------------------------------------|-------------|------------------------------|--------------------------------|
| 4 av. 3095                                                                                                                                                               | 4 av. 2880                                    | 4 av. 2870                                          | Wet         | 4 av. 2135                                                | 4 av. 2080                                                  | Wet         | Long Island beach sand*      | Long Island beach gravel       |
| 4 av. 2410                                                                                                                                                               | .....                                         | 4 av. 1720                                          | Very wet    | 4 av. 2225                                                | 4 av. 1930                                                  | Wet         | Long Island washed bank sand | Long Island washed bank gravel |
| 4 av. 2415                                                                                                                                                               | 2 av. 2585                                    | 3 av. 2060                                          | Wet         | 4 av. 1980                                                | 4 av. 1705                                                  | Wet         | Long Island beach sand*      | Long Island beach gravel       |
| 4 av. 2760                                                                                                                                                               | 4 av. 2020                                    | 4 av. 1775                                          | Very wet    | 4 av. 1900                                                | 4 av. 1910                                                  | Wet         | Long Island beach sand*      | Long Island beach gravel       |
| 16 av. 2670                                                                                                                                                              | 10 av. 2480                                   | 15 av. 2110                                         |             | 16 av. 2060                                               | 16 av. 1910                                                 |             |                              |                                |
| If concrete 90 days old be assumed to be 25 per cent stronger than the same concrete 28 days old the corresponding totals for 28 days would be approximately as follows: |                                               |                                                     |             |                                                           |                                                             |             |                              |                                |
| 2150                                                                                                                                                                     | 2000                                          | 1700                                                |             | 1650                                                      | 1550                                                        |             |                              |                                |

\*Coarse and well graded, not the very fine sand usually described as "sea-beach sand."

TABLE 3—TESTS OF CONCRETE CUT FROM ACTUAL STRUCTURES

| Strength, lb. per sq. in. | Proportions | Age       | Description                              | Fine aggregate               | Coarse aggregate               | Consistency |
|---------------------------|-------------|-----------|------------------------------------------|------------------------------|--------------------------------|-------------|
| 1—4250                    | 1:2:4       | 127 days  | 6-in. Cube                               | Sand                         | Gravel                         | Wet         |
| 1—1870                    | 1:2:4       | 15 months | 8½x8½x17 in. rough dressed, not polished | Long Island washed bank sand | Long Island washed bank gravel | Very wet    |
| 3 av. 3340                | 1:2½:4½     | 30 months | 6x6x12 in.                               | Cow Bay sand                 | Gravel                         | .....       |

cut from actual structures, while they were setting, varied from 3 ft. to 15 ft., and the superiority of these specimens over those cast in molds may have been partially due to this circumstance. The specimens which were subjected to the greatest heads were not the strongest, however.

Results are given in Table 3 for some tests of miscellaneous concrete pieces cut from structures and tested at various ages. It is seen that one rough-dressed specimen gave a relatively low value at the age of fifteen months. The smooth dressing of the field-cut specimens probably influences favorably the test results.

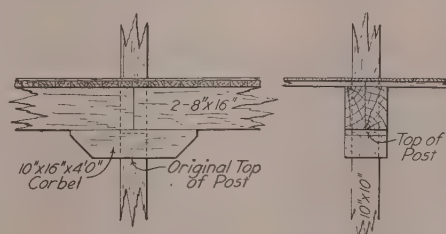
Alfred Craven is chief engineer, Robert Ridgway is engineer of subway construction, and George L. Lucas is general inspector of materials for the Public Service Commission. R. E. Goodwin, who furnished the foregoing data, is in charge of tests of concrete and concrete aggregates.

FUNDS FOR IMPROVING AND MAINTAINING ROADS in California totaling \$1,793,680 have been turned over to State and county authorities by the State motor vehicle registration department. This money represents receipts from automobile and motor-cycle registrations during the fiscal year just ended. The apportionment of expenditures from the fund in the various counties will be made in accordance with the amount each has contributed. The widely different conditions are shown by the variations in revenue; the amount contributed from Alpine County was \$87, while Los Angeles County's share was \$604,443.

was commonly found throughout the investigation.

The case in question is that of a building in the produce section of Chicago. About a year ago the owner was notified by the building authorities to strengthen the floors of the building. These floors were very much out of level, being bowed up around the columns as much as 10 in. in some cases. It was a puzzle to know how the floor was supported, as some of the girders seemed to be without visible means of support. The conditions found in one case are shown in the accompanying figure. The posts, girders, and corbel were all of yellow pine. Originally the bottom of the corbel rested on the top of the post. The post had been forced upward into the corbel, so that it came within an inch of the post above, almost shearing off the corbel.

An investigation was made to determine how it was possible for a post of this size to be forced through 9 in. of yellow pine. The old basement floor was uncovered to obtain information in regard to the footing. As shown in the second diagram, this



POST FORCED THROUGH CORBEL BY FROST

## Draw Span of Harlem River Bridge Floated to Place

Old Span Removed at 5.45 A. M. and New 1100-Ton Double-Deck Four-Track Span Floated In and Put in Service by 12.42 P. M.

ON the high tide at 8 a. m. Sunday morning, Aug. 22, the new double-deck 1100-ton draw-span of the rebuilt bridge which carries the Second and Third Avenue elevated lines across the Harlem River in New York City was floated in place on four barges and lowered with twenty-four sand jacks. The first train was run over the new span at 12.42 p. m.

The two double-deck approach spans were placed in the same manner on Feb. 22 and March 7, as described on page 341 of the Engineering Record for March 31, 1915. On the same falsework used to erect the approach spans end to end, the new draw span was built. Its erection was practically finished last May, and it was first planned to place it at that time. The use of the upper deck for the new express service, however, depended on the completion of other improvements in the elevated roads, which will not be ready for train service until next month. As it was found that several changes in the operating machinery of the new span would be desirable, these changes were therefore made without any delay to the operation of the new system, and the draw span was not put in place until they had been completed.

On Saturday afternoon four large barges were floated into four bays in the falsework, two under each end of the draw span. On them had been erected timber bents carrying sand jacks, the 3-ft. square timber pistons of which were fastened to the grillage of 24-in. I-beams which capped the falsework and on which the span had been erected. As the tide rose this grillage and the bridge with it was picked up. Several tension members of the span had been stiffened with wood, as the operation of raising the span by its ends put them in compression.

The barges were started out at 6 p. m. by sets of falls pulling from the falsework and the shore ends of the barges, and operated by hand. Several snub lines were used, these precautions being needed because of the scant clearance between the barges and the falsework, and the very narrow channel into which the span was floated between the falsework and the fender pier of the Willis Avenue bridge. As soon as the span was clear, it was towed upstream and tied



NEW SPAN BEING LOWERED TO PLACE

up for the night at the company's dock on the Manhattan side of the river just below the elevated railway bridge.

### TWO BARGES LIFT OLD SPAN

With the next rising tide, shortly after 2 a. m., two barges were set, one under each end of the old draw span. The bents erected on them came to a bearing as the tide rose, when the scows were jacked down to an additional displacement of about a foot, with eight hydraulic jacks. The final lift which cleared the old span from the piers was made with the tide. The old span was floated and towed out at 5.45 a. m. It was tied up temporarily to the New York, New Haven & Hartford Railroad's dock opposite the company's dock. It was removed to the company's dock later in the morning. Here it will be dismantled by two derrick boats working from the ends in.

The new span was swung across the steam and towed up into place as soon as the old span was tied up. While these operations were going on, two "jinny-winks," one mounted on the upper deck of each of the approach spans, set the wedges and shoes on the end piers. The ring segments for the center pivot had been previously installed inside the rim bearing of the old span on the center pier, which bearing was supported on a steel frame from the

rim of the pier while this work was done. The new pivot casting and discs were assembled on the deck of a derrick boat which was tied up west of the center pier. As soon as the old span was out this derrick boat removed the old rim spider and its temporary support, and set the new pivot casting.

### NEW SPAN ADJUSTED

The new span was adjusted in exact location with wire ropes and steamboat ratchets, and timber guides were bolted from its end posts to those of the approach spans. At 8.55 a. m. the first sand was let out of the jacks. Lowering with the jacks and the tide continued until about 11 a. m. When the 5½-ft. drop of the jacks was exhausted the span had been landed and the barges had risen almost to their light displacement. The falling tide permitted the removal of the scows in a short while, the north pair, the last to be removed, being towed clear at 11.45 a. m.

The bridge was then swung for the first time, when it developed that an angle on the end wedge failed to clear the shoes at one end of the bridge by the specified amount. This angle was readily removed and trimmed. The operating mechanism of the bridge worked perfectly, and 12.42 p. m., as soon as the track crew and electricians had completed the last end connections on the lower deck, the first train was allowed to pass over the bridge.

The walkway on the east side of the bridge, the end panels of which had been removed on all the spans to lessen the chance of interference, were replaced during the day by crews working with the jinny-winks.

A feature of the operation was the precision with which the three tugs handled their unwieldy tows in the cramped quarters of the Harlem River. There was no interference, no bumping and no loss of time. The spans and barges moved exactly as it was intended they should, and the whole change went through as planned, without anything that could be called a hitch.

Construction on the section of the Manhattan elevated improvements in which the bridge is located is being carried on by the forces of the Terry & Tench Company, Inc., under H. D. Robinson, engineer, and W. L. Cline, superintendent. The entire work on the elevated lines is being designed and supervised by the Interborough Rapid Transit Company, of which George H. Pegram



TIDE ABOUT TO LIFT NEW SPAN FROM ERECTION FALSEWORK—OLD SPAN FLOATED OUT, THE NEW SPAN IS BEING PLACED

is chief engineer, F. W. Gardiner, principal assistant engineer, and S. Johannesson, general assistant engineer. Bernard O'Rourke is assistant engineer in charge at the bridge. E. J. Govern, vice-president of the T. A. Gillespie Company is in general charge of construction on the Manhattan elevated improvements for the contractors, who are the two companies mentioned and the Snare & Triest Company.

### Increased Radius of Curb at Street Corners Aids Traffic

AT most street intersections the radius of the curb at the street corner is such that a motorist desiring to turn the corner finds it impossible to describe an arc of turn that will enable him to maintain a moderate rate of speed and still keep his machine on the proper side of the pavement while turning into the cross street. The radius of the curb curve is usually but little over 1 ft.; hence the driver cannot commence to turn until he has practically passed the corner. Increasing the radius of the corner curve to 12 or 14 ft. will permit most types of cars to turn a corner at the same distance from the curb as when driving down the street.

Changes such as suggested by the accompanying pictures have been made at several street intersections in Chicago, notably at



LEFT — INCREASED CURB RADIUS ALLOWS EASY TURNS

Lincoln Parkway and Diversey Boulevard, and at Devon and Evanston Avenues. Without such construction a driver turning into an intersecting street would have to cross its center line and could not pass two cars coming toward him. Increasing the radius of the curve permits the driver to follow the arc of the curb and thus keep to the right of the center line of the street where he properly belongs. Such an improvement is particularly desirable on boulevards or where other streets intersect with boulevards. It is likewise desirable at intersections of narrow streets.

ADMINISTRATION EXPENSES of the Board of Water Supply of New York City, to the end of 1914, had amounted to nearly 1.07 per cent of the cost of constructing the city's new water supply. The total sum spent for administrative purposes since the projects were launched in 1905, according to the Board's annual report for 1914 has amounted to \$1,313,419.57. This does not include engineering expenses for surveys, plans and immediate supervision of the work.

### Missouri Utility Commission Requires Pure Water

Filtration, Sterilization and Technical Analysis  
Recommended—Meter Accuracies and  
Periods of Service Limited

SPECIAL RULES regulating gas, electric and water utilities laid down by the Missouri Public Service Commission will go into effect Oct. 1. They apply to municipalities as well as to private plants. The special references to water contain strict provisions as to the quality, meter accuracy and test limits, fire service and pressure. All water for domestic use must be free from disease-producing organisms or injurious chemical or physical substances, and must be agreeable to the eye and nose. Water which rarely shows the presence of members of the B. coli group and which has a reasonably low bacterial count under the usual standard test methods will ordinarily be considered safe from the standpoint of disease-producing organisms.

Filtration of surface waters is recom-

utility pays the fee; otherwise the consumer settles. Meter testers are to be maintained by each utility furnishing cities of 3000 people or more.

### Chicago Autotruck Service Reduces Hauling Charges

Transportation Section in Water Department  
Maintains General Delivery Service—Monthly  
Average Costs Per Ton-Mile Given

AUTOTRUCK hauling costs have averaged 13 cents per ton-mile with a 5-ton truck and have varied from 14 to 32 cents per ton-mile with a 2-ton truck, in the Department of Public Works, Chicago. Under contract by teams in 1914 the average was 26.9 cents per ton-mile, and hauling by teams hired by the day was still higher, according to the latest annual report of John Ericson, city engineer. He concludes that motor trucks are economical and efficient when properly handled, that hauling of certain materials by contract is ad-



RIGHT—SHORT RADIUS CURVES HINDER TRAFFIC

visable, and that teams hired by the day are not efficient.

The departments equipment consists of one 5-ton and three 2-ton Pierce-Arrow trucks operated under the direction of the superintendent of pipe yards.

A system of delivery of material has been

#### COST OF OPERATING AUTOTRUCKS

| 5-Ton Truck No. 1 |         |           |                           |                   |         |
|-------------------|---------|-----------|---------------------------|-------------------|---------|
|                   | Mileage | Ton-miles | Operating expense per day | Cost per ton-mile |         |
| July              | 824     | 1931      | \$259.28                  | \$9.97            | \$0.134 |
| August            | 838     | 1914      | 257.05                    | 9.88              | 0.134   |
| September         | 723     | 1744      | 237.96                    | 9.91              | 0.136   |
| October           | 902     | 2045      | 267.39                    | 10.28             | 0.13    |
| November          | 1014    | 2299      | 300.78                    | 13.07             | 0.13    |
| December          | 950     | 2339      | 293.52                    | 12.33             | 0.125   |
| 2-Ton Truck No. 2 |         |           |                           |                   |         |
| July              | 911     | 926       | 210.16                    | 8.40              | 0.227   |
| August            | 934     | 1017      | 209.89                    | 8.40              | 0.205   |
| September         | 800     | 948       | 197.69                    | 8.98              | 0.201   |
| October           | 1091    | 1044      | 225.79                    | 8.36              | 0.216   |
| November          | 1111    | 1256      | 189.54                    | 7.90              | 0.15    |
| December          | 559     | 536       | 159.69                    | 11.41             | *0.31   |
| 2-Ton Truck No. 3 |         |           |                           |                   |         |
| July              | 721     | 770       | 192.74                    | 9.13              | 0.25    |
| August            | 930     | 908       | 208.78                    | 8.70              | 0.23    |
| September         | 725     | 631       | 191.94                    | 9.14              | 0.30    |
| October           | 1038    | 864       | 218.97                    | 8.11              | 0.25    |
| November          | 1039    | 470       | 162.32                    | 7.06              | *0.345  |
| December          | 778     | 651       | 254.79                    | 10.62             | *0.40   |
| 2-Ton Truck No. 4 |         |           |                           |                   |         |
| July              | 816     | 478       | 201.34                    | 9.15              | 0.42    |
| August            | 973     | 792       | 221.04                    | 9.21              | 0.27    |
| September         | 948     | 778       | 211.69                    | 9.62              | 0.272   |
| October           | 831     | 769       | 217.99                    | 9.08              | 0.283   |
| November          | 1097    | 1155      | 137.19                    | 8.14              | 0.16    |
| December          | 974     | 983       | 182.56                    | 7.02              | 0.186   |

\* The high ton-mile cost on Truck 3 for November and December is due to the character of service, which consisted of small loads, long hauls and an excess of loading time. The same is true of No. 2 truck for December.

mended and sterilization is considered advisable for all water furnished. Utilities are urged to employ water analysts in a consulting capacity to make frequent tests. When this is not feasible tests are to be made at least twice yearly, preferably in the late spring and early fall. The commission reserves the right to require an extended examination at any time. Results must be kept on file for public inspection.

In all towns of 2500 inhabitants or more a graphic recording gage must be maintained. Dead ends in mains are to be avoided. Meters may show no more than 5 per cent error. Tests must be made on 5/8-in. meters at least every ten years or after passing 100,000 cu. ft., 3/4-in. after eight years or after passing 150,000 cu. ft., 1-in. meters after six years or after passing 300,000 cu. ft. All meters above the 1-in. size must be tested every four years. Upon request the utility must make a test free provided the meter has not been tested within the previous twelve months. The laboratories of the State University school of engineering are made the referee. Tests cost \$2 each for sizes under 1 in. In case the meter is fast beyond the regulation the

instituted so that it was unnecessary for the district foreman to send to the yards for material. Regular deliveries are made to the district yards and the cost of hauling such material has been greatly reduced. As far as possible all pipe and material are delivered directly to the job on which it is to be used. The efficiency of this system of deliveries has been made possible by the use of the motor trucks which were purchased early in the year. The costs of operating the trucks have been reported monthly and a summary of this data is given in the accompanying table.

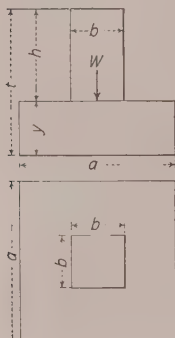
## Reinforced-Concrete Footings Economically Designed

Equations Derived for Computing Dimensions of Single Slab and Pedestal to Give Minimum Volume When Shear Governs Design

By N. M. STINEMAN

Engineering Department, Chicago, Milwaukee & St. Paul Railway, Chicago

IT IS very seldom, perhaps, that any attempt is made to proportion column footings so that they will contain the minimum quantity of concrete required for the work to be done. Reinforced-concrete footings



consisting of a bottom slab and a pedestal occur quite frequently in practice. The depth of the bottom slab is usually determined by the punching shear induced by the tendency of the pedestal to "punch" through the slab. Formulas 1 and 2, when the value of the allowable punching shear is inserted, will give at once the dimensions required for the minimum quantity of concrete in the entire footing, without the necessity of resorting to the usual cut-and-try method.

The following notation will be used in the derivation of the formulas:  $W$  = total load at base of pedestal;  $p$ , unit soil pressure in pounds per square foot (the weight of the bottom slab being disregarded);  $v$ , allowable punching shear in pounds per square inch;  $h$ , height of pedestal in inches;  $t$ , total height of footing in inches;  $y$ , computed depth of bottom slab in inches, giving the minimum quantity of concrete in the entire footing, for selected values of  $v$ ;  $a$ , one side of square slab in inches;  $b$ , one side of square pedestal in inches;  $4by$ , punching shear resisting area (hence  $v = W/4by$  and  $b = W/4vy$ );  $Q$ , quantity in cubic inches of concrete in slab and pedestal.

In the above notation,  $W$  and  $p$  are known in any given case;  $t$  is known in any given case, since the elevations of the top of the pedestal and the bottom of the slab are likely to be established by outside considerations;  $h = t - y$ ;  $a$  is determined from the

required slab area, and  $b$  can be found after  $y$  is computed.

The total quantity of concrete in the footing may now be written

$$Q = b^2h + a^2y$$

But  $b = W/4vy$  and  $h = t - y$ ; hence

$$Q = W^2(t - y)/16v^2y^2 + a^2y$$

Differentiating this equation with respect to  $y$  and writing the first derivative equal to zero, the result is

$$y^2 + (W^2/16a^2v^2)y = W^2t/8a^2v^2$$

But  $a^2 = 144W/p$ , so that the equation may be written in the convenient form

$$y^2 + (Wp/2304v^2)y = Wpt/1152v^2 \quad (1)$$

And as previously stated,

$$b = W/4vy \quad (2)$$

After the selected value of  $v$  is inserted, equation 1 may be readily solved by trial, with the assistance of a table of cubes and a slide-rule.

Equation 1 shows that the bottom slab may be either square or rectangular. If the pedestal is rectangular, it should have a perimeter equal to  $4b$ .

### EXAMPLE

The following example illustrates the use of equations 1 and 2:

Given a column load of 245,000 lb., an allowable soil pressure of 5000 lb. per square foot, an allowable punching shear of 90 lb. per square inch, and a total depth of 7 ft. 6 in., find the dimensions of a footing of the type shown, so that the quantity of concrete will be a minimum.

In this case  $W = 245,000$ ,  $p = 5000$ ,  $v = 90$  and  $t = 90$ . Substituting these values in equation 1, the value of  $y$  is found by trial to be 21.8 in.; and from equation 2, the value of  $b$  is 31.2 in. Actually, the values of  $y$ ,  $b$  and  $h$  may be taken at 22, 32, and 68 in. respectively.

The bending moment in the bottom slab must also be computed, but in this case, as usual, the depth of the slab is determined by the punching shear, even though the latter has been taken at a high value.

## Thirty Miles of Chesapeake & Ohio Northern Begun

First Link of Chesapeake & Ohio Extension to Columbus Runs Northward from Parent Road and Includes Sciotoville Bridge

THE GENERAL FEATURES of the bridge being built over the Ohio River at Sciotoville, Ohio, were described in the Engineering Record of June 26, page 799. This bridge is the principal structure on the Chesapeake & Ohio Northern Railway, the 94-mile subsidiary of the Chesapeake & Ohio Railway to be built from Columbus, Ohio, to a junction with the main line of the latter system on the Kentucky bank of the Ohio River. At present only 30½ miles are under construction—from a temporary connection with the main line 1½ miles north of the ultimate junction at Edgington, Ky., to a temporary connection with

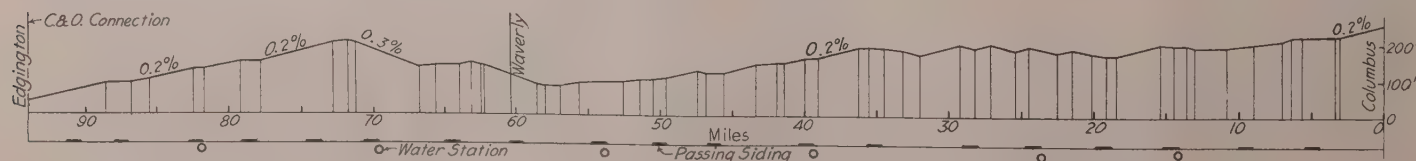


WORK NOW UNDER WAY, AND ULTIMATE EXTENSION TO COLUMBUS

the Norfolk & Western Railway at Waverly, Ohio.

The route and condensed profile of the work now under construction and the continuation north to Columbus are shown in the accompanying drawings. The section now being built opens up new territory from 6 to 8 miles east of the Norfolk & Western, but from Waverly north the new road will closely parallel the latter line, remaining, however, on the east side of the Scioto River for the entire distance. With the exception of steeper temporary run-off grades at the ends of the line the ruling gradients will be 0.2 per cent northbound and 0.3 per cent southbound. The sharpest curves will be 2 deg. and the total curvature will be 1098 deg., for entire line of 94 miles. As the profile shows, the line is laid out with 6000-ft. passing sidings averaging 4½ or 5 miles apart. Of the six water stations contemplated, two come on the 30-mile section now being built.

Apart from the Ohio River bridge, the



CONDENSED PROFILE OF ENTIRE LINE—RULING GRADES 0.2 PER CENT NORTHBOUND AND 0.3 PER CENT SOUTHBOUND



man from this department for a few days; in this case we give them the best general advice we can, but no detailed plans or specifications, and before leaving we give the names and addresses of some engineers in that part of the State with the hint that in the future some one of them will prove available.

In many instances county officials have spent road money year after year without securing any permanent results, and what is worse, have no idea that there is any better manner of carrying on the work. Private engineers have neither the time nor the money to do the necessary missionary work, but this department by bulletins, letters, road meetings and personal visits does what it can to arouse these communities and get them in step with the march of progress.

One of the most important fields covered by the engineers of this department is the preparation of preliminary reports regarding the cost of road construction in the various counties or road districts. Practically all the highways built in the State are financed by bond money, but since this money is not available until the bond election is carried and the bonds are sold, there is no money for the brief preliminary survey which is necessary in order to determine approximately how large the bond issue must be to secure the desired results. This preliminary report does not include any detailed plans or specifications, but it does give the approximate cost of grading, bridges, surfacing, etc.

To illustrate, I recently made a preliminary report for a road district in south Texas, where it is the intention to spend \$75,000. After dealing at some length with local conditions of soil, climate and present road conditions I made the following recommendations regarding the spending of the money:

|                                               |          |
|-----------------------------------------------|----------|
| For engineering and supervision.....          | \$5,000  |
| For widening right-of-way, relocation, fences | 8,000    |
| For grading .....                             | 15,000   |
| For permanent bridges and culverts.....       | 22,000   |
| For sand-clay construction.....               | 5,000    |
| For gravel surfacing.....                     | 20,000   |
| Total .....                                   | \$75,000 |

I further stated that this would give an adequate right-of-way on all the roads, would build all the bridges of permanent material, would grade all the roads, would put a sand-clay surface on all the stretches of sand, and would put a gravel surface on 8 miles of road that was in heavy soil.

It may be said that this report will tie the hands of the engineer that may be in charge of the actual construction, and there is some truth in that, but when an engineer goes to that community and charges them from 5 to 7 per cent for engineering and supervision, these people will not "drop dead with surprise"; when he tells them that wooden bridges and culverts are not economical he stands a fair show of being believed, and when he demands the condemnation of a new right-of-way through "Tom Jones' field or Bill Brown's pasture" in order to get the road out of a creek bottom he will find the sentiment of the community behind him. I might further state that there were three months last winter when the roads in this community were impassable, that last March a bond issue for road improvement was defeated, but that the good-roads advocates in this district by using the report mentioned as campaign material carried

this bond issue in June for \$75,000 by a vote of 200 for to 72 against.

There is no question but that it is hard to tell just where State aid of this character should stop, but that some such aid is needed is evidenced from the fact that within the past twelve months I have personally covered sixty-seven assignments in fifty-one different counties in this State. We further believe that our system of working is getting results and is doing no injury to anyone. I have yet to hear any real adverse criticism from an engineer, while many engineers in the State have expressed their hearty approval.

B. K. COGLAN,  
Associate Professor of Highway Engineering,  
Agricultural and Mechanical College of Texas.  
College Station, Tex.

### Freak of Tornado Near Lebanon

SIR: In passing through Lebanon, Pa., I picked up the accompanying photograph showing a freak of the tornado at Annville on Aug. 21. Trees were blown flat, many houses lost their roofs, one house had the front blown off and much local damage was



BARN RESTING ON ITS ROOF AS RESULT OF TORNADO NEAR LEBANON

done. The barn shown was completely overturned and now rests on one side of its roof.

CARL P. BIRKINBINE.

Philadelphia.

### How Is Glass Graded?

SIR: The writer had occasion the other day to inquire into the grading of sheet glass, as usually used in buildings in the United States in this year of enlightenment, 1915, and he finds many different descriptions of glass in architect's specifications, some referring to thickness, others to quality, but, so far, has been unable to find any architect, testing laboratory, engineer, manufacturer or manufacturer's agent who could give any written description as to what the various qualities covered. AA is AA, and a better quality than A. A is A glass; it is a better quality than B. It should be reasonably free from defects. B is a B-quality glass, and is subject to some defects. This is about as far as the information goes.

We should be very glad if you or your readers could put us wise to any recognized grading on either sheet or plate glass, either

plain, factory ribbed, wired or other varieties. It would seem that those who deal in it the most are as innocent of what constitutes first quality as those to whom they sell.

ABERTHAW CONSTRUCTION COMPANY,  
By J. Arthur Garrod,  
General Superintendent.

Boston.

[The Engineering Record would be glad to hear from its readers on this matter.—EDITOR.]

### Use for Waste Clay Products

SIR:—We have eight clay plants here and are interested in finding some way to utilize the waste products, consisting of broken brick, sewer pipe, etc., all of which is vitrified.

We have been making some inquiries with a view of crushing this waste and using it for building construction, etc. Have you any data covering experiments of vitrified clay, crushed and used in concrete instead of crushed stone? Kindly put us in touch with any experimenters who have reported their investigations along this line. Our people are dumping hundreds of carloads of

this annually which should be turned into a profit, especially in sections of the country where suitable stone is not to be had. Any information or assistance in this matter will be thankfully accepted.

CHARLES W. COLLINS,  
Secretary, Chamber of Commerce.  
Brazil, Ind.

[Suggestions might be made direct to Mr. Collins.—EDITOR.]

CINCINNATI FACES A WATER RATE INCREASE.—The net increase of the cash balance was only \$26,115.30 during 1914, making a total of \$215,673.13, an amount positively needed to tide over periods of large interest and sinking fund payments, according to J. A. Hiller, general superintendent, in his latest annual report. The revenues have been used only for operation, maintenance and interest and sinking fund. No improvements have been made directly from receipts, but Mr. Hiller recommends that when the rates are raised the increase be such that a large proportion of the betterments can be paid for from current revenue rather than from borrowed money.

# HINTS FOR THE CONTRACTOR

## Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, and should be accompanied, if possible, by photographs or sketches.—EDITOR.]

### Wrecked Dredge Raised from Timber Bridge Between Dump Scows

By O. S. PROCTOR  
Camden, New Jersey

THE STEEL hull of a dredge boat sunk in the Delaware River at Trenton, N. J., was recently raised to the surface in halves by tackle suspended from timbers which rested on two dump scows and straddled the wreck. The dredge was a one yard machine, with a steel hull 17 x 70 ft. in plan and 5 ft. deep, made up in seven 10-ft. sections. The dipper, dipper stick, boom and boiler were first removed by a derrick boat. One diver reported the hull broken near the center and the stern portion buried in silt and covered by the wreckage of the superstructure. The bow, which was upstream, had caught logs and brush, but not much silt.

We planned to raise the boat with what scows we had available, by hitching on at low tide and floating into shallow water at high tide. The barges used were two 60-yd. dump scows and a large deck scow used to carry coal. First we located the backstays, which were attached to the hull at the stern corners. These were hitched to long U-bolts straddling the door logs of the dump scows near the center, thus getting the full lifting capacity of the scows. We allowed the stern to rise and fall with the tide several times, thus clearing the way to sweep a line under the dredge to near its center. When this line was in place, the hitch to the stern of the dredge was

the dump scows were separated to straddle the wreck, and the hitches transferred to long timbers which reached from one scow to the other and bore on the door logs near the center of each boat. All the hitches were made with blocks and falls, so that the small derrick boat used could take up on the load line and raise each corner a few feet at a time in turn. The wreck was brought to the surface in this way and landed in shoal water at high tide.

When the wreck was landed on the slope of the channel, the break in the hull was completed, so that each half of the hull was taken out separately in the manner described. The wreckage and mud have been cleaned out of the two halves, and bulkheads are to be built in their open ends so that they can be floated together and the hull rebuilt.

### Turntable Aids Road Contractor in Solving Hauling Problem

CONFRONTED with the problem of unloading industrial cars into an end loading mixer with track and mixer both on subgrade, an Illinois highway contractor building a State-aid concrete road north of Chicago on Milwaukee Avenue successfully solved his difficulty by placing a turntable in front of the mixer skip. About 1000 ft. from the mixer a switch is placed affording a double track to the turntable at which point the tracks are joined again by means of a frog. As a result one track can be used for loaded cars and the other for sending back empties.

As the contractor has only one engine on the job, cars are pulled to and from the turntable by a horse, the engine being used to bring the material from the railroad to the switch. Upon arriving at the switch

lower end of the switch from flat cars on the siding to the hopper cars on the main track. As a rule six bags are used per batch but this is changed according to the condition of the stone. The average train consists of from fifteen to twenty cars. About sixty-five cars and 4 1/4 miles of



SIDE DUMP CARS FEED END-LOADING MIXER FROM TURNTABLE

track are in use. The dead haul is 1.6 miles and the average haul 3.85 miles.

W. I. Sieber is the foreman in charge for Walter & Windes, of Glencoe, Ill., the contractors. A. F. Keehner is the resident engineer for the State, reporting to H. B. Bushnell, division engineer.

### Dynamite Safely Removed from Missed Holes with Air

BY INSERTING the end of a hose, or short length of pipe, in a blast-hole that has failed to go off, turning on a light pressure of air through a valve from the drill line, and withdrawing the pipe with the pressure on, the unexploded dynamite may be removed with safety. The work should be done with care, and too much air pressure should not be turned on. This method was advocated by Jacob S. Langthorn, in a paper read at a recent meeting of the Brooklyn Engineers' Club, in preference to attempting to drill a new hole alongside the unexploded one. The latter practice is compulsory in New York City, under section 188 of the rules of the Municipal Explosives Commission.

The paper, which outlined the effective methods used in handling explosives on the Catskill Aqueduct tunnels, and the discussion which followed, dealt with tunnel practice, where the holes in the heading are all drilled at an angle. No one can be sure where the end of such a hole, 8 or 10 ft. from the face, is located, and when one of them has missed, it was asserted, it is dangerous to drill another hole anywhere near



TIMBERS SPREAD DUMP SCOWS SO WRECK CAN BE RAISED BETWEEN THEM

moved near one end of the scows, and the line which had been dragged under the scow was hitched near the other end of the scows. These hitches were straight up through the pockets, the scows riding over the wreck.

The bow of the wreck was picked on timbers projecting over the end of the coal scow. With this arrangement the wreck was moved about 500 ft. upstream and landed on the slope of the channel. Here

the engine is detached and run onto the siding, picking up its train of empties. The loaded cars are then pulled by the horse to the turntable. The turntable is attached to the mixer by means of a steel strut.

At the railroad each hopper car is loaded by hand with enough sand and gravel for a batch for the 1-yd. mixer. Cement is placed on flat cars in sufficient quantities to allow six bags per car for each hopper car in a train, and is transferred at the

it. That the practice of attempting to drill a new hole in a tunnel heading where one or more holes of a round have missed is much more dangerous than withdrawing the unexploded charge with care, especially where compressed air is used, was unanimously asserted by several tunnel engineers of wide reputation, who took part in the discussion of the paper. John R. Healy, inspector of combustibles of the Bureau of Fire Prevention, stated that where compressed air was used as described the charge followed the pipe out of the hole as if it were a piece of iron and the pipe a powerful magnet. Others who advocated withdrawing a missed charge in tunnel work instead of drilling a new hole were Robert Ridgway, engineer of subway construction for the Public Service Commission, and formerly a department engineer on the Catskill Aqueduct, and F. J. McIsaac, of Grant, Smith & Company and Locher, contractors for a large part of the New York City tunnel of the aqueduct.

### Large Sand Jacks Work Well in Lowering 1100-Ton Span

THE SAND JACKS illustrated herewith lowered successfully a load of more than 45 tons apiece, at a pressure of 92 lb. per square inch, for a distance of more than 5 ft. in landing the 1100-ton draw span of the Harlem River elevated railroad bridge, described elsewhere in this issue. The jacks as originally built to handle the approach spans had a total drop of 5 ft. This was increased by building up the timber casing with three more courses of 6 x 8-in. timber, as the draw span submerged the scows deeper than the approach spans did. The angles on the casing were extended by straps bolted in line with them. After the first drop had been exhausted, the bridge was landed, but all the load was not off the scows. The bolts in the top section added to the casing of each jack were then re-

moved, the timber taken out one course at a time, and the remaining sand let out. This allowed the scows to rise until they were free.

As seen in the drawings, the casings were a part of the timber falsework erected on the scows that lifted the span. The pistons, each made of nine 12 x 12-in. timbers, were bolted to the I-beam grillage on which the span was erected. The casings were filled with dried sand, and the barges spotted under the span at low tide and allowed to float up until the pistons engaged the casings and came to a bearing on the sand. As the weather was rainy, canvas was tied around the top of each

is riveted a square steel plate which fits over the hole. The lever is moved aside to let sand escape, and back to shut it off.

Credit is given in the article mentioned to the men connected with moving the span. The jacks were designed by H. D. Robinson, chief engineer on the Manhattan elevated improvements for the Terry & Tench Company, Inc.

### Locomotive Crane Mounted on Boat to Clean Irrigation Ditches

TO REMOVE silt from waste-water ditches on the Minidoka irrigation project in Idaho the U. S. Reclamation En-



NOVEL TOOL DOES WORK OF FLOATING DREDGE ON SMALL DITCHES

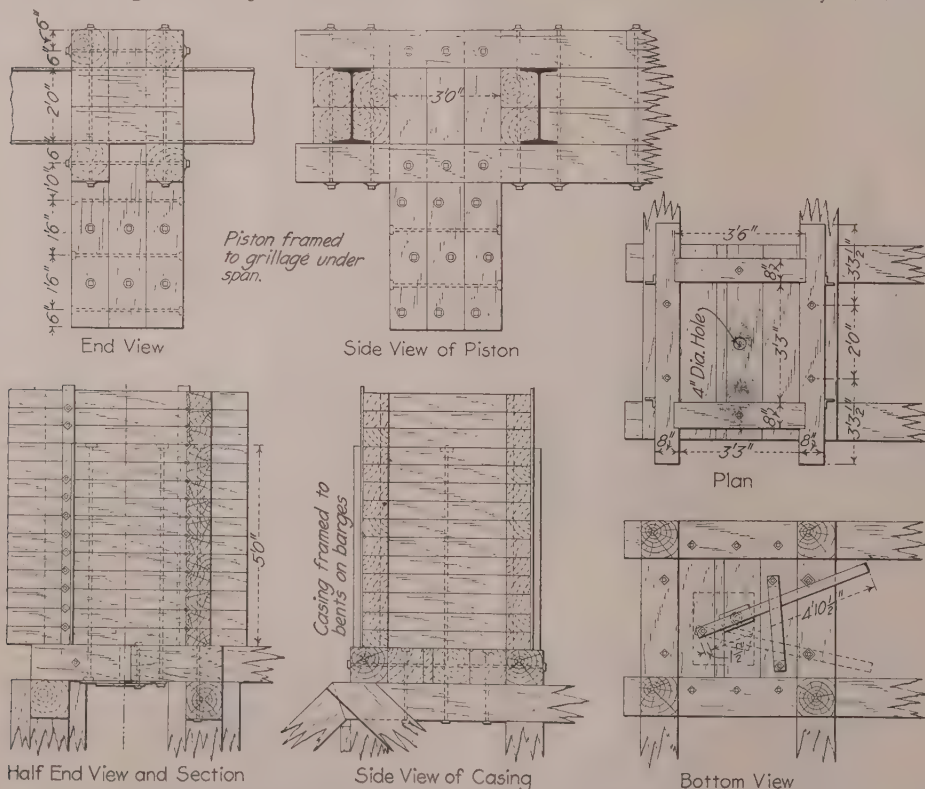
casing and tar paper tacked over the outside to keep the sand from getting wet.

The gates, though simple in detail, were very effective, and gave close control over the lowering. A man was stationed at each gate. Each gate consists of a hole in the timber floor of the casing, blocked by a lever made of a flat steel bar, to which

engineers purchased a Brownhoist locomotive crane and mounted it, without trucks, under-frame or cab in a steel barge built to fit the cross-section of the ditches. The crane operates a grab bucket, and is run by a 40-hp. gasoline engine. This novel tool has replaced hand labor and scrapers on ditches which are too small to allow the use of an ordinary floating dredge. It is said to have effected a great saving. It draws only 3 ft. of water when in operation. As it fits the cross-section of the ditch closely, and as the rotating parts of the crane are of course balanced, it is used without spuds.

The barge is pulled along by running out a line ahead from a hand crab, one of which is located in each end of the hull. Work on this project is being carried on by the U. S. Reclamation Service, for which F. N. Cronholm is superintendent of construction.

THE ROOF CONSTRUCTION of a small demonstration building that remained undamaged through the severe tornado of March 27, at Adel, Iowa, is described in the July number of the *Brick and Clay Record*. It is of hollow brick construction and self-supporting, the load being carried by bricks which were keyed to form a complete arch. The walls of the structure were carried up to the top course in the usual manner, after which a special cornice block was laid. An extra heavy band of plow steel was carried around this and a single row of brick was tamped in against it, firmly embedding it into the wall, as a reinforcement against the thrust at the heel of the arch formed by the roof. The bricks were then laid in concrete, each course being completed before the next one was laid.



TAKING TOP TIMBERS OFF CASINGS DURING LOWERING ALLOWS FULL DROP

# NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

## Government Engineers Study Los Angeles County Problem

Seven members of the United States Rivers and Harbors Board of Engineers arrived in Los Angeles on Aug. 16 to spend a week in making an official inspection of the harbor and an examination of waterways to serve as a basis for a report to congress on the diversion of flood waters in Los Angeles County. The party included Col. W. M. Black, Col. Lansing H. Beach, Col. Henry C. Newcomer, Major Edward N. Johnston, Col. Frederick V. Abbott, Lieut.-Col. E. E. Winslow and H. W. Webber, secretary of the board.

Major Robert R. Raymond, U. S. A., stationed at Los Angeles, conducted the party on its local tour of inspection. After visiting the harbor itself the proposal to build a direct channel to connect it with Long Beach harbor was considered. The proposed widening of the entrance channel of the harbor to a minimum of 1000 ft., the deepening of the entrance channel and turning basin to 35 ft. and widening of the east basin channel and the dredging of the area south of Reservation Point were also considered.

The present inspection was the result of a request made by the Los Angeles Harbor Commission to the Congressional Rivers and Harbors Committee that a general survey of the harbor be made as a basis for considering further improvement. The Harbor Commission called attention to the fact that in the past forty-four years the Government has spent less than \$6,000,000 in improvements for Los Angeles harbor, while in the six years since the harbor has been under the jurisdiction of the city, Los Angeles has voted bond issues aggregating \$5,500,000 for harbor improvements, of which sum \$800,000 is still unspent. And the city stands pledged to vote \$4,500,000 more bonds for the same work before 1920.

## Dexter Brackett Dies

Dexter Brackett, for the past eight years chief engineer of the Metropolitan Waterworks, Boston, Mass., died at his residence in Brighton on Aug. 26. Mr. Brackett was widely known as a hydraulic engineer and was recognized as an authority in many branches of waterworks engineering. He was born at Newton, Mass., in 1851, was graduated from the Brighton High School in 1868, and soon after entered the employ of the city of Boston, being attached to the waterworks branch of the engineering department. For forty-six years he served in the engineering departments of the city and State, and took a very prominent part in the development of the water supply of Boston and of the Metropolitan water district. His work for the city related mainly to the piping system and other distribution equipment, and the system which developed largely under his direction was noted for its adequacy and the excellence of its various parts. After twenty-six years of service with the city of Boston, Mr. Brackett was called to take charge of the distribution department of the Metropolitan Waterworks, which included the piping system, pumping stations and reservoirs within the Metropolitan district, and he was largely responsible for the excellence of these works. The pumping stations at Chestnut Hill and Spot Pond have been visited by engineers from all parts of the country, and are regarded as models of efficiency.

In 1907 Mr. Brackett became chief engineer of the Metropolitan Waterworks, and in this capacity he has had charge of the maintenance and operation of the system and of the construction of additions, including the success-

ful hydroelectric plant at the Wachusett dam in Clinton, Mass. He was also responsible for the design of a similar plant now under construction at the Sudbury dam in Southborough. One of the important reforms which have taken place since he held the position of chief engineer, and largely through his efforts, is the introduction of water meters into the municipalities of the Metropolitan district, which has reduced the water consumption to such an extent that the district now has a supply of water adequate for many years to come. It was recently estimated that the water consumption with the use of meters is somewhat less than two-thirds of what it would have been if meters had not been introduced. Without these, an additional supply

Chief Engineer of Boston's Metropolitan Waterworks Whose Death Ends Long Service



DEXTER BRACKETT

would have been necessary, and at great cost. Mr. Brackett was a member and for three years a director of the American Society of Civil Engineers, and had been president of the Boston Society of Civil Engineers and of the New England Waterworks Association. He contributed papers of value upon waterworks topics to the proceedings of various engineering societies.

## Alaska Engineering Commission Moves Seattle Offices

The Seattle offices of the Alaska Engineering Commission have been moved from the L. C. Smith Building to the Port of Seattle's new Bell Street warehouse, at the foot of Bell Street.

## Montana Dam Dedicated

The completion by the Montana Power Company of the Great Falls dam on the Missouri River near Great Falls, Mont., was celebrated quietly by informal dedication ceremonies, Aug. 11. President John D. Ryan and a small party of officials and invited guests were present at the initial passage of the waters over the crest of the dam.

## Boston Port Directors Approve High Pressure Pumping Station Site

The Port Directors of Boston approved the proposed site at the corner of Dorchester Avenue and the Summer Street Bridge as a suitable location for the high pressure fire service pumping station at a hearing held in that city, Aug. 31, and the matter now goes before the War Department for whatever recommendation its engineer, Col. William E. Craighill, Corps of Engineers, U. S. A., may decide to make. Corporation Counsel Sullivan stated that the Federal engineer had already expressed his willingness to consider this site. Mayor Curley of Boston and other public officials are anxious that this matter be settled promptly as several miles of high pressure mains were laid last year and as many more have been put in this season.

## Illinois Engineers Examining Board on Licensing Is Named

Governor Dunne has appointed the following engineers on the examining board in accordance with the recently enacted structural engineers license law: E. N. Layfield, assistant secretary, Western Society of Engineers; J. W. Musham, of the Condron Company; Frank T. Hanley, of the Corrugated Bar Company, all of Chicago, and C. C. Stowell, consulting engineer and formerly city engineer of Rockford. The fifth member is Professor Ira O. Baker, of the State University. These men have been named from a large list of names submitted to the governor by the legislation committee of the Western Society of Engineers. Mr. Layfield was designated president of the board and Mr. Hanley secretary.

## Ten-Car Special Train to Carry Engineers to San Francisco

Up to noon of last Wednesday 128 passengers were assured for the special train which will carry engineers to the International Engineering Congress at San Francisco. At that time reservations were coming in faster than cancellations, and it was believed that the eight Pullman cars then in the train would likely be increased to nine or ten. Reservations at Chicago insure the adding of at least one car to the train there. In addition to the Pullman equipment there will be the usual complement of dining and baggage cars. G. S. Harner, passenger agent of the New York Central Railroad, who has charge of the arrangements, will accompany the train to the coast.

## Association of Engineers to Hold Chicago "Booster" Dinner

Invitations have been sent by the recently organized American Association of Engineers to the engineering departments of all the principal railroads, corporations and firms in the City of Chicago to attend a booster dinner to be held at the Hotel La Salle, Sept. 14, 1915. Prof. F. H. Newell, head of the department of civil engineering at the University of Illinois, and who, until recently, was director of the U. S. Reclamation Service, will speak at this dinner on the "Needs of Organization Among Engineers."

A 30 per cent increase in membership, drawn from all parts of the United States as well as from all branches of the engineering profession, has been registered by this organization during the past two weeks. Local chapters are being formed in St. Louis, Milwaukee, Indianapolis and many of the larger cities. A National convention is to be held at

the La Salle Hotel, Chicago, Dec. 10 and 11. All engineers are invited and the engineering societies and clubs of the United States are urged to be represented by engineering delegates. Further information may be obtained by addressing Arthur Kneisel, secretary, 29 S. La Salle Street, Chicago, Ill.

### May Lease Chicago Garbage Plant to Private Firm

A plan to lease part of the Chicago municipal garbage reduction plant to a private firm is being fostered by Dr. John D. Robertson, Chicago's new health commissioner. The city purchased the old plant of the Chicago Reduction Company Feb. 1, 1914. For it and its reconstruction the city has paid to date \$742,922 and it contemplates a further expenditure of \$371,000. The plant has been operated for a year at a loss, but in a sanitary manner. Instead of taking the grease out of the garbage—the valuable product—it has sold the tankage at \$5.77 per ton. To extract the grease it would be necessary to use the millhouse and naphtha plant, both of which have remained idle. For the tankage the best price obtainable for the ensuing year is \$3.27 per ton.

Dr. Robertson proposes to rent the old millhouse and degreaser to a contractor, who shall pay a certain price for the tankage that will be turned out by the remainder of the plant. He recommends that scheme to the finance committee for a period of ten months.

"From the information I have collected," he said, "I believe that, from each 4 tons of garbage, a ton of tankage can be had. With grease at 3 cents a pound and fertilizer at \$4.50 or \$5 a ton, a ton of tankage will bring in about \$10. I understand that it costs about \$3 a ton to get the grease out." Last year the city's garbage, hauled by municipal teams, totaled 129,211 tons. That would mean about 32,000 tons of tankage. At \$10 a ton the income is \$320,000 a year.

Dr. Robertson's plan was described by Oscar E. Hewitt in the *Chicago Herald* for Aug. 16. In Mr. Hewitt's words it is as follows: "The city will operate the end of the plant where most of the jobs are. The contractor will operate the money-making end of the plant."

### Professorship Established as a Memorial to Joseph A. Holmes

As a memorial to the late Dr. Joseph A. Holmes, director of the Bureau of Mines, of the Department of the Interior, the Colorado School of Mines has established the Joseph A. Holmes Professorship of Safety and Efficiency Engineering.

### Total Asphalt Production in 1914 Shows Increase

Although there was a decrease in the market production of natural asphalt and of manufactured or oil asphalt derived from domestic sources in the United States in 1914, the decrease was more than offset by the greatly increased output from American refineries, of oil asphalt derived from crude petroleum imported from Mexico.

The decline in asphalt production from domestic sources is attributed by J. G. Northrop of the U. S. Geological Survey to the increasing use of the product manufactured from Mexican oils. The production of oil asphalts from domestic petroleum amounted to 360,683 tons, valued at \$3,016,969, and the output from the American refineries of oil asphalt from Mexican petroleum amounted to 313,787 tons, valued at \$4,131,153. Compared with 1913, the output of natural asphalt in 1914 declined 16 per cent and that of domestic oil asphalt 17 per cent, but the output of Mexican oil asphalt increased 174 per cent. In California there was a notable increase in the output of oil asphalt derived solely from domestic petroleum, which resulted largely

from an increase in the use of asphalt in highway and pavement construction in that State. In Texas and Utah the output of certain varieties of naturally occurring asphalt required for special purposes showed an increase. Asphaltic material and products to the value of \$186,142 were imported for consumption during the calendar year. Exports during the same period amounted in value to \$1,247,020, leaving a balance of \$1,060,878 to be credited to the domestic asphalt industry.

### Gooseneck on Derrick That Lifted 37 Tons Breaks Under 21½-Ton Load

Mystery surrounds the breaking on Aug. 19 of a 2½ x 12-in. steel gooseneck, which held the 16 x 16-in. 50-ft. Oregon Fir mast of a



Courtesy Chicago Daily News

LIFTING A 21½-TON TOP SECTION CHORD CAUSED THIS DERRICK FAILURE

derrick used in the construction of the west end of Chicago's new Jackson Street lift bridge. The gooseneck broke at the joint as the 4-ft. square laced steel boom, 118 ft. long, was lifting a 21½-ton top section chord. The back stiff leg of the derrick is made of 12 x 14-in. timber and is uninjured. The boom, in falling, hit the partly erected leaf and was crushed near the center. Four sheave blocks were used, two at the top of the mast and two at the bottom. A ⅝-in. cable was used at the drum and a ⅝-in. cable for the lift.

Engineers for the contractor, the Strobel Steel Construction Company, Chicago, have as yet been unable to determine the cause of the failure. The gooseneck has been examined by the Pittsburgh Testing Laboratories and found to be made of best quality steel. To add to the mystification of the engineers, the derrick, which is designed to lift many more than 21½ tons, had lifted 37 tons the day previous without apparent distress to the gooseneck.

### Loss in Galveston Probably from Three to Four Million Dollars

Later advices, received from John B. Hawley, consulting engineer, of Fort Worth, Tex., in regard to the damage done by the hurricane of Aug. 16-17 at Galveston, which was described in this journal last week, indicate that the property loss, public and private, will probably be from \$3,000,000 to \$4,000,000.

The 30-in. water main from Alta Loma lost several hundred feet at different points through erosion of the bay bottom. A temporary 8-in. main connects the island with the mainland, but its capacity is too small to give an adequate supply and water is being doled out in small quantities. The total loss of life on the island may reach 100. A careful ex-

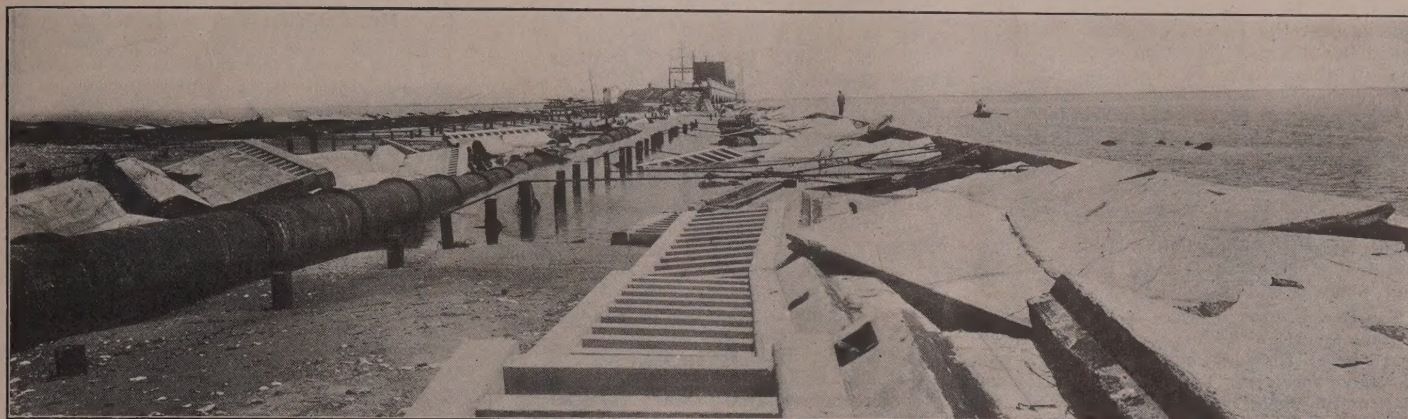
amination of the sea wall showed it to be wholly uninjured and, according to Mr. Hawley, "indicated that its designers provided for every necessary element of strength."

The arch portions and bascule of the causeway are practically intact, but that part which is of retaining-wall and earth-fill type is largely destroyed. A temporary trestle is being built to serve traffic needs until the arch construction can be extended to both shores.

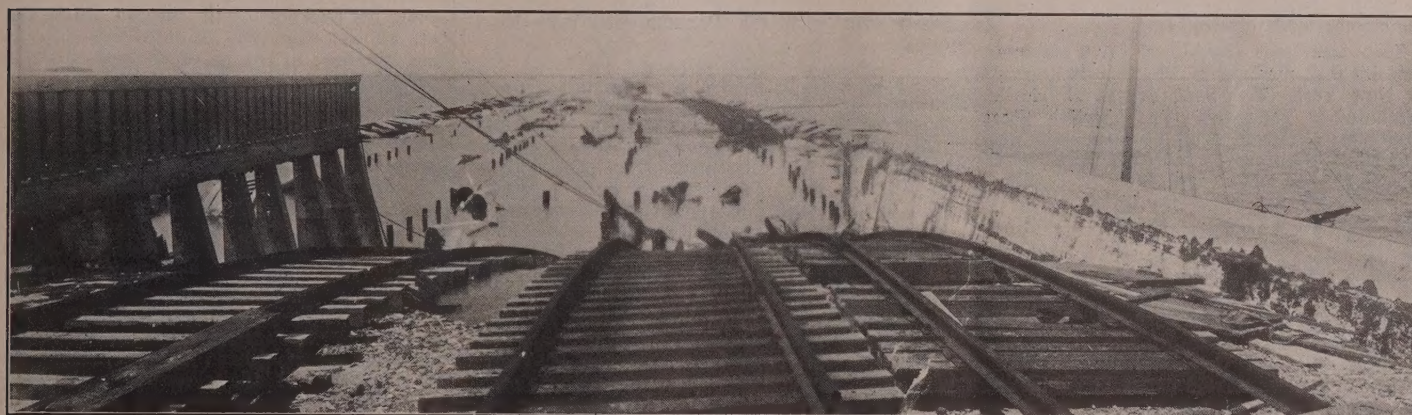
Lieut.-Col. Charles S. Riche, Corps of Engineers, U. S. A., in charge of the Galveston district, is authority for the statement that the great jetties, which made Galveston's deep water channel, are practically unharmed and that soundings show that the channel itself suffered no filling or accumulation of sand bars.

The city, aided by the U. S. Army, is cleaning up the streets and alleys. The citizens are working on their own premises.

# The Aftermath of the Galveston Storm



THE 30-INCH WATER MAIN FROM ALTA LOMA WAS UNDERMINED AND BROKEN AT SEVERAL PLACES



PART OF THE CAUSEWAY WHICH IS OF THE RETAINING-WALL AND EARTH-FILL TYPE WAS LARGELY DESTROYED



PHOTOGRAPH SHOWS CEMENT SIDEWALK AND PAVING WHICH REMAINED INTACT AND SAVED FILLING FROM WASHING OUT



THE ONLY PLACE WHERE SAND WAS WASHED FROM BEHIND SEAWALL—WHERE MEN STAND A SHIP WAS CARRIED OVER WALL

## American Society Rescinds Licensing Action of 1911

Announcement was made Sept. 1 at the meeting of the American Society of Civil Engineers that the canvas of votes relative to rescinding the society's action of several years ago in the matter of licensing engineers showed that the society had rescinded that action by a vote of 2024 to 594. This leaves the board of direction free to act in the matter as the occasion may demand.

## News of Engineering Societies

The Missouri Valley Public Health Association will meet at the Coates House, Kansas City, Sept. 28 and 29.

The San Francisco Association of Members of the American Society of Civil Engineers heard M. O. Eldridge, engineer, U. S. Bureau of Roads, speak on "Types of County Roads," at a meeting held in that city, Aug. 20. On unanimous motion of those present a motion was referred to the board of management of the local association providing that a course in public speaking for engineers be provided for members who desired it.

The American Society of Civil Engineers held its first meeting of the 1915-1916 season in New York City, Sept. 1. E. E. Howard presented a paper on "The Twelfth Street Trafficway Viaduct, Kansas City, Missouri," and H. R. Stanford presented a paper on the "Pearl Harbor Drydock."

## Personal Notes

W. A. BOUVÉ, formerly engineer for the General Chemical Company, at Bay Point, Cal., has been appointed assistant engineer at the mines of the Mountain Copper Company near Keswick, Cal. Mr. Bouvé has been engaged in engineering work since 1907. Among the companies he has been connected with are the Southern Pacific Railway System, the Associated Pipe Line Company and the Associated Oil Company. He entered the service of the General Chemical Company in 1914.

BRUNO PIZZIMENTI, general contractor, formerly of Seneca Falls, N. Y., has entered into partnership with Martin & Miller, engineering contractors and sanitary experts, of Caldwell, N. J. The firm name of the new organization will be Martin-Miller & Pizzimenti.

MARK F. BOYD, formerly bacteriologist of the State Hygienic Laboratory of Nevada and associate professor of bacteriology in the State University at Reno, has resigned to become epidemiologist in the laboratory of the Iowa State Board of Health.

ALBERT J. HIMES, formerly valuation engineer of the New York, Chicago & St. Louis Railroad, at Cleveland, has been re-appointed engineer of grade crossing elimination, with headquarters in the same city. He was graduated from Cornell University in 1887 and entered railway service as assistant engineer with the Burlington & Missouri River in the same year. After two years in this position he went to the Fall Brook Railway as assistant engineer on maintenance. He served from 1891 to 1893, as city engineer of Corning, N. Y., organizing meanwhile, the contracting firm of A. J. Himes & Company. From 1894 to 1897 he was resident engineer on the eastern division of the New York State Canals, after which he was with the U. S. Board of Engineers on deep waterways. He entered the employ of the New York, Chicago & St. Louis as bridge engineer in 1901 and was appointed assistant chief engineer in 1907. He served as engineer of grade elimination from 1909 to 1913. In the latter year he was appointed valuation engineer.

J. H. HOSKINS, formerly chief engineer of the Dickson County (Tenn.) Highway Commission, has been appointed chief engineer of the Rhea County Highway Commission, with headquarters at Dayton, Ohio.

E. E. EAST, formerly inspector for the California State Highway Commission, has been promoted to the grade of assistant division engineer.

MAJOR HORTON W. STICKLE, Corps of Engineers, U.S.A., who is at present in charge of the river and harbor works in Baltimore and vicinity, has applied for retirement from active service under the special act of Congress authorizing retirement with advanced rank for all officers who served at least three years on the construction of the Panama Canal. He was graduated from West Point in 1899 and served in the Philippine Islands until 1901, in charge of road work and bridge construction. He was instructor in civil and military engineering at West Point from 1904 to 1905, and from the latter year until 1907, served as assistant to the officer in charge of construction at the academy. He was assigned to service in connection with the Panama Canal in November, 1907.

COL. JOHN BIDDLE, Corps of Engineers, U.S.A., who was recently military observer for the United States in Austria, will succeed Major Horton W. Stickle, whose application for retirement from the active list of the army is noted elsewhere in these columns, in charge of river and harbor works in Baltimore and vicinity. Colonel Biddle was graduated from West Point in 1881 and was a student at the Engineers School of Application at Willet's Point, N. Y., from then until 1884. From 1884 to 1887 he was on surveys in the Dakotas and Montana. He served as instructor in engineering at West Point from the latter year until 1891, and was in charge of lock and dam construction and open channel work on the Tennessee and Cumberland rivers from then until 1898. He spent two years in the Philippine Islands, in charge of road construction, and harbor improvements at Manila, leaving there in 1901 to take charge of bridge and building construction in the District of Columbia, including the construction of the Connecticut Avenue Bridge. In 1907 he was detailed in charge of works in the Sacramento and San Joaquin rivers in California. He was appointed military observer to Austria in November, 1914.

FREDERICK J. CELLARIUS, consulting engineer of Dayton, Ohio, and H. J. Dressler have been appointed sanitary engineers in charge of the establishment of a new sanitary sewer district at Harrison Township, Ohio.

E. A. MORITZ, engineer U. S. Reclamation Service, formerly located at the Washington, D. C., office has been appointed office engineer of the recently established executive office at Denver, Col.

JAMES BURTON has resigned from the office of superintendent of waterworks of Fort Scott, Kan., and has opened an office in that city to engage in a general engineering practice, specializing in water service problems.

CHARLES E. HEWETT has resigned from the office of architect for the Iten Bisquit Company to engage in a contracting business at Omaha, Neb.

G. J. POYSKY has been appointed engineer and superintendent in charge of Diking District 1 in Cowlitz County, Washington, with headquarters at Kelso. This enterprise involves the reclamation, by a system of diking and drainage, of 3000 acres of land that is, at present, subject to overflow during the June freshets.

RAYMOND GLADDING, of Albuquerque, N. M., has received an appointment as junior engineer on the forces of the United States Engineer, and has been assigned to the Rivers and Harbors division of the service. Mr. Gladding was graduated from the University of New Mexico two years ago, and took a post graduate course at the Massachusetts Institute of Technology which he finished last June.

E. W. HESS, consulting engineer, of Clearfield, Pa., has been retained by the borough of Punxsutawney to prepare estimates and other information for submission to the Public Service Commission of Pennsylvania, in the borough's effort to obtain permission to install a municipal waterworks system.

EARL TALBOTT has resigned from the office of resident engineer in charge of the New York City residency of the New York State Barge Canal.

EDWARD ANDERBERG, formerly assistant engineer in charge of bridge and lock construction on the New York State Barge Canal, at Lockport, will succeed Earl Talbott, whose resignation is noted elsewhere in these columns, in charge of terminal work in New York City and vicinity.

E. C. CHURCH, formerly chief of the Bureau of Supplies of the Department of Water Supply, Gas & Electricity, New York City, and later assistant manager of the Marconi Company, has been appointed deputy warden of Sing Sing Prison, New York, as assistant to Thomas Mott Osborne, whose revolutionary methods of handling the prisoners at that institution have attracted widespread interest through the East. Mr. Church will give special attention to the organization of the prison and to placing the administration of the shops on a business basis. He has been engaged in organization work of this character, in a consulting capacity, for some years. His work in organizing the Bureau of Supplies of the department of water supply was described in a remarkable report, which was reprinted in large part in this journal, issues of Jan. 3, 10, 17 and 24, 1914.

OTTO A. STELLER AND W. L. SCHWALBE have become associated as consulting civil engineers under the firm name of Steller Engineering Company, engineers and contractors, Loan & Trust Building, Milwaukee, Wis. Mr. Steller was formerly associated with N. H. Smith in consulting practice at Oshkosh, Wis. Previous to that he was on the engineering staff of the Chicago, Milwaukee & St. Paul Railway and of the railway and highway commissions of the State of Wisconsin. Mr. Schwalbe has been on the engineering staff of the Milwaukee Electric Railway & Light Company of Milwaukee, and the engineering staff of the city of Milwaukee.

FARLEY GANNETT, consulting engineer of Harrisburg, Pa., with whom is associated Theodore E. Seelye, has been employed by the city of Erie, Pa., to investigate and report upon methods of preventing a repetition of floods in Mill Creek. This work is the result of the disastrous flood of Aug. 3 which caused the loss of 34 lives and \$2,000,000 in property. A force of 24 engineers is at work on a topographic survey of the creek through the city and of reservoir sites and deflection schemes in the upper water shed.

R. T. CHILDS, editor of the construction news department of Engineering News for the past six years, has resigned in order to engage in the development of several large real estate tracts at Mineola, Long Island. He will be associated with the Shawmut Realty Company and with the Mineola Homes Company. Mr. Childs was graduated from Rensselaer Polytechnic Institute in 1903.

**WILLIAM C. COFFIN**, formerly structural engineer of the Jones & Laughlin Steel Company, has been elected vice-president of the Knox Pressed & Welded Steel Company, manufacturer of all classes of steel plate construction and welded steel specialties, of Pittsburgh. He was connected with the Jones & Laughlin Company since 1908. Previous to that he was vice-president of the Riter-Conley Manufacturing Company. His new office will include the duties of general sales manager of the Knox Company.

**B. GRANGER**, formerly inspector in the Bridge Department of Cuyahoga County, Ohio, has been appointed field superintendent for Albert Kahn, architect, 58-60 Lafayette Boulevard, Detroit, Mich.

**HOWARD K. BELL**, engineer and contractor, of Lexington, Ky., who has been located at Campbellsville, Ky., where he designed and constructed a waterworks system for the town, for the past year, has removed to Eminence, Ky., where he has a contract to build three concrete bridges on the Eminence Road in Shelby County under State aid. Previous to taking up private work, five years ago, Mr. Bell was, for more than eight years, chief engineer and general manager of the Lexington waterworks.

**AVERY J. PRATT**, who was engaged on United States Navy survey of American Samoa, has returned to this country, the field work of the survey having been completed, and will go to Washington within the next week or so to work up the notes.

**GEORGE W. RICHARDS**, who has been connected with the bridge and construction department of the Pennsylvania Steel Company of Steelton, Pa., has resigned to accept a position in the Cleveland office of the bridge department of the New York Central Railroad.

**RICHARD K. MEADE**, chemical, mechanical and industrial engineer, of 202 North Calvert Street, Baltimore, Md., has been retained by the D. M. Bare Paper Company, Roaring Springs, Pa., to prepare plans for and superintend the construction of a lime recovery plant.

**BEERS BUILDING COMPANY**, Pittock Block, Portland, Ore., has opened offices in the L. C. Smith Building, Seattle, Wash. This concern was recently awarded the contract for the construction of the superstructure of the Fremont Avenue bridge across the Lake Washington Canal in Seattle.

**R. K. HALLET**, formerly civil engineer with the Brookings Timber & Lumber Company at Brookings, Ore., is now engaged as civil engineer for the Hercules Powder Company on the construction of a new plant at Hercules, Cal. While with the Brookings company Mr. Hallett was engaged in the construction of a modern lumber mill and several miles of standard-gage railroad, which included the first railroad bridge ever built in Curry County, Ore.

**W. H. COGGESHALL**, formerly superintendent for the Cummer Lumber Company of Jacksonville, at Colee, Fla., has entered into a partnership with George R. Foster, Jr., to engage in a contracting business at Bradentown, Fla. For the present they will engage in drainage canal construction.

**RAFAEL GONZALEZ**, formerly assistant engineer in the Department of Sanitation of Porto Rico, has been engaged by the Fajardo Sugar Company for work in connection with the location and construction of about 5 miles of canals to irrigate about 2000 acres of that company's property at Fajardo, P. R.

**RAY PALMER**, formerly commissioner of gas and electricity of Chicago, has resumed his consulting engineering practice, with offices in the Hartford Building, Chicago. His lines are the general supervision of reorganizations, valuations, rates, lighting and industrial problems, requiring engineering and accounting service.

**W. D. BEARDSLEY**, formerly connected with Viélé, Blackwell & Buck, consulting hydraulic engineers, 49 Wall Street, New York City, has formed a partnership with J. A. Dougan and F. A. Beardsley to engage in an engineering and contracting business under the firm name of Beardsley, Dougan & Beardsley, with offices in the Macbain Building, Roanoke, Va. The firm will specialize in land and topographic surveys, preliminary surveys and estimates for railways, hydroelectric and other engineering developments, superintendence and engineering on construction and, as contractors, in concrete work.

**A. S. HUNTSMAN**, formerly assistant engineer on the primary roads of the State of Washington, is now in charge of the construction of the "Vancouver North" link of the Pacific Highway, at Ridgefield, Wash.

**THOMAS C. ATWOOD** has opened an office in the Chamber of Commerce Building, New Haven, Conn., where, in addition to his work on the Yale Bowl, he will engage in general practice as a consulting engineer, making a specialty of water and sewerage works, power development, private estates and athletic fields. He was graduated from the Massachusetts Institute of Technology in 1897, and was for three years employed on the Metropolitan Waterworks of Boston and, for a year, on the harbor works of that city under the United States Engineers' Office. In 1901 he went to Philadelphia and was engaged upon the construction of the filtration works there until 1904, when he went to Pittsburgh to engage in similar work. In 1907 he was appointed designing engineer on the Catskill Aqueduct work and, later, as division engineer in charge of the Bronx Division, including some ten miles of aqueduct within the city limits. This position he resigned in order to accept that of division engineer on the Jerome Park filter plant for the filtration of the Croton Supply of New York City at a cost of about \$9,000,000. In 1914 he resigned this position to take charge of the construction of the Yale Bowl, the major portion of which has been finished, the remaining work now occupying but a part of his time.

## Obituary Notes

**EDWARD B. PLEASANTS**, chief engineer of the Atlantic Coast Line Railroad, died in Washington, D. C., Aug. 22.

**MAX HEBGEN**, vice-president and chief engineer of the Montana Power Company, of Butte, Mont., died in Chicago, Aug. 24, at the age of forty-six years. He was born in Milwaukee and began his career in the hydroelectric development of this country with the Standard Underground Cable Company and the Westinghouse Electric Company about twenty-nine years ago. He located in Butte in 1886 as a lineman with the old Butte Electric Light & Power Company and remained continuously in its employ through its various absorptions, attaining, previous to his death, the office of vice-president and chief engineer of the Montana Power Company, which has water-power developments on the Big Hole River; the Missouri River, at Great Falls; the Yellowstone River, at Billings, and two large developments on the Madison River. This company, according to H. M. Byllesby, of H. M. Byllesby & Company, engineers, of Chicago, who was formerly its president, is a monument to the creative genius of Mr. Hebgen.

**JOHN W. EBER**, until recently general manager of the Toronto, Hamilton & Buffalo Railway, died in Hamilton, Ont., Aug. 18. He was born in 1871 and entered railway service in 1890, as rodman with the West Shore Railroad. In 1896 he was appointed assistant roadmaster and in 1899 supervisor of track. He became connected with the New York Central & Hudson River Railroad, in

1902, and was appointed division engineer in that service two years later. In 1905 he attained the grade of engineer of track and, in 1905, was appointed assistant superintendent of the company's stock yards at Buffalo. He reached the grade of superintendent of the Adirondack division in 1910, from which office he resigned to go to the Toronto Hamilton & Buffalo as general superintendent in 1912. He was appointed general manager in 1913.

**J. C. METCALFE**, former president of the Mexican International Railway and recently consulting railway expert for Speyer & Company, bankers of New York City, died at Pocono Summit, Pa., Aug. 31, at the age of sixty-seven years. He was general manager of the Denver & Rio Grande from 1900 to 1901 and general manager of the Evansville & Terre Haute from the latter year until 1902 when he was appointed president of the Mexican International. He served as vice-president of the Manila Railway Company and made extensive investigations in railway problems in Peru, Chili and Ecuador. He also aided in solving the transportation problems of the London Underground Railway Company, of which he was a director.

**JOHN H. WARDER**, secretary of the Western Society of Engineers for the past 15 years, died in Chicago, Aug. 30. Mr. Warder was born in Cincinnati, Jan. 21, 1846. He was graduated in mechanical engineering from the Polytechnic College of Philadelphia in 1867. During the first several years out of college he was employed by the Cincinnati Southern Railway System. He then went with the Phoenix Iron Works, Detroit. He was engaged in 1893 as construction engineer by the Illinois Electric Forging Company and others in planning power and electric plants. He also planned in the same year the West Pullman, Ill., waterworks. From 1893 to Jan. 10, 1901, when he assumed his last position, Mr. Warder was in charge of sewer construction in various parts of Chicago.

**J. C. W. GRETH**, manager of the water purifying department of Wm. B. Scaife & Sons Company, Pittsburgh, died Aug. 7. He was graduated from Cornell University in 1897 and was first engaged with the Snow Steam Pump Works, Buffalo, designing special machinery. He entered the service of the Wm. B. Scaife & Sons Company in 1902 and remained in it continuously up to the time of his death.

**CHARLES T. WILLS**, president of Charles T. Wills, Inc., contractors and builders, 286 Fifth Avenue, New York City, died in Greenwich, Conn., Aug. 31, at the age of sixty-four. He started his life's work as an apprentice bricklayer and worked along subordinate lines until he became a partner in the firm of Sinclair & Wills in 1873. Among the buildings erected by his company are such structures as the Emigrant Industrial Savings Bank Building, New York City, the New York Stock Exchange, and the American Banknote Building.

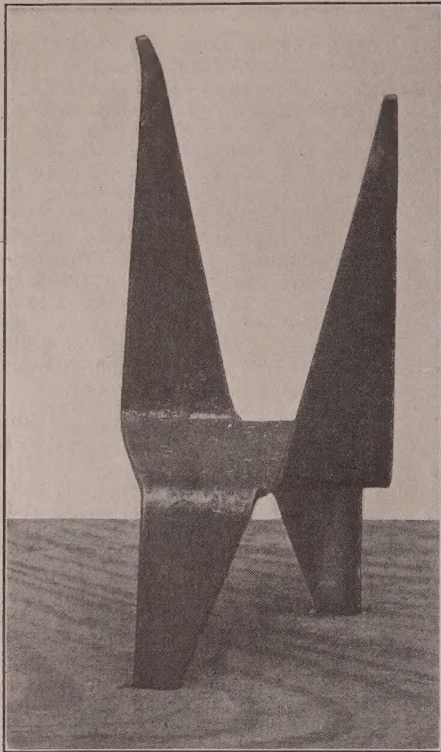
## Civil Service Examinations

### Examinations Previously Announced

| Date                                                                                                                             | See Eng. Record |
|----------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Sept. 11—Assistant examiner, Civil Service Commission, Philadelphia .....                                                        | Aug. 21         |
| Sept. 15—Aid, U. S. Coast and Geodetic Survey; draftsman and junior engineer, U. S. Engineer Department .....                    | July 3          |
| Sept. 18—Lock operator, New York .....                                                                                           | Aug. 21         |
| Sept. 22—Assistant irrigation engineer, United States .....                                                                      | Aug. 21         |
| Oct. 13—Aid, U. S. Bureau of Standards; civil engineer and draftsman, draftsman, Navy Department; engineer, Indian Service ..... | July 3          |

## Chair for Reinforcing Bars Insures Exact Placing of Steel

A new chair for holding reinforcing bars in place, which apparently goes against what has hitherto been considered good practice inasmuch as its prongs are driven into the wooden form, yet which, on actual work, has given no



PRONGS IN WOOD HOLD LOAD RIGIDLY

trouble from this source and which, according to the manufacturers, holds the reinforcement permanently in its proper position, has been placed on the market by the Shop-Fabricated Reinforcement Company of Cleveland, Ohio. This chair, known as the "Staple Chair," which is shown in the accompanying illustration, is made from extra stiff sheet steel, cut and bent to develop two pairs of pointed prongs, projecting in opposite directions. It is placed before the steel is and driven into the form work as far as is desired, and in the exact position the steel is to occupy. Then the rod is placed and the upper prongs bend down over it with a blow of a hammer. The chair has been used on actual work and no trouble was experienced in form removal due to the driven-in points.

## Factograf Camera Photographs Meter Readings

The Factograf camera which has been developed by the Eastman Kodak Company of Rochester, N. Y., not only reads water, gas and electric meters, but prevents disputes by recording the meter reading just as it was when taken. The reading is made by placing the front of the camera against the meter dial and pressing downward on the exposure lever. This automatically turns on a light, which is a part of the device, opens and closes the shutter and turns off the light. The shutter locks automatically with each exposure, and remains locked until the film for the next exposure has been wound into place, when it automatically flies back into the "set" position. This prevents the possibility of taking two records on one section of film. In the same manner there can be no blanks, for the film cannot be wound off until the exposure has been made.

The camera measures  $4\frac{1}{4} \times 5\frac{3}{4} \times 12\frac{1}{4}$  in. and is made from selected mahogany, specially treated to stand severe moistures.

Light is furnished from two dry batteries stored in either side of the camera. By pressing a small button, the lights may be turned on to assist in locating meters or finding one's way through dark cellars. The combined cost of films and chemicals for developing does not exceed fifty cents per hundred readings.

## Carnegie Structural Beams

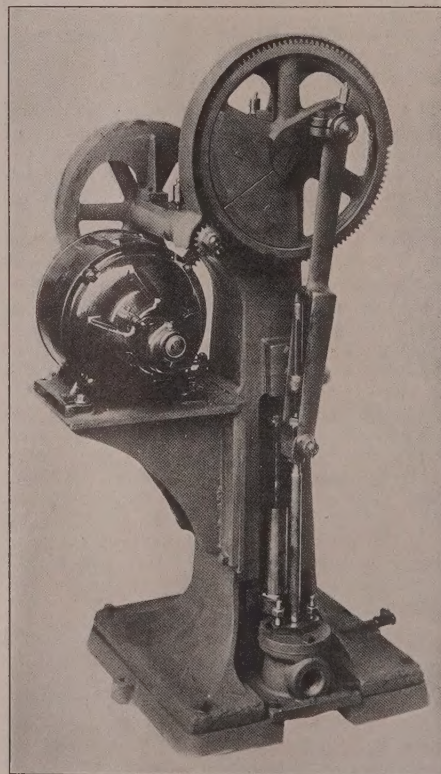
The second edition of the small booklet on "Structural Beams" has just been issued by the Carnegie Steel Company, Pittsburgh, Pa. It supersedes and cancels the first edition, and the data on supplementary beams in the sixteenth and seventeenth editions of the Pocket Companion and the fifth edition of the Shape Book.

In addition to the profiles of these deeper, wide-flange beams rolled by the company, the booklet gives the usual tables of properties and safe loads. The beam sections vary by 3 in. in depth from 24 in. to 12 in., and are rolled with thin webs and wide flanges. The slope of the flanges is uniformly 1 in 11. The theoretical carrying capacities are somewhat less than the corresponding minimum weights of standard sections, but the metal has equal or greater efficiency pound for pound, with the added advantage that the new sections have greater lateral stiffness.

## New Pumping Head That Is Wholly Self Contained and Very Compact

The new Hill pumping head, manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., which is wholly self-contained and very compact, will raise water to heights of 180, 125 and 90 ft. respectively, when operating 2-in.,  $2\frac{1}{2}$ -in., or 3-in. single acting cylinders. It can be used in connection with open or elevated tank systems or with closed tank pneumatic pressure systems.

Westinghouse Electric,  $\frac{3}{4}$ -hp., single phase, type AR motors are used. The motor is mounted rigidly on an extension of the pump support and is capable of starting the pump under full load. All gears are machine cut and well protected. When used with the pneu-



THIS UNIT IS ADAPTED FOR ELEVATED AND PNEUMATIC PRESSURE SYSTEMS

matic pressure system, an air pump furnishes air to the tank through the water discharge. Water is raised on the upstroke while air is forced in on the downstroke, thus equalizing the pressure.

It is claimed that the outfit can be operated twenty-four hours every day, and that it requires practically no attention.

## Business Notes

The Independent Concrete Pipe Company, State Life Building, Indianapolis, of which Howard Schurman is general manager, has opened a branch office in Columbus, Ohio, at the Lazarus Building.

The Virginia Bridge & Iron Company has opened a branch office in Denver, Col., to cover the territory embraced in the states of Kansas, Colorado, Arizona, New Mexico and Utah. A. R. Payton, who has been associated with the company for some years as contracting engineer, will be in charge of the new office, which is located in the First National Bank Building.

The Penn-Allen Cement Company of Allentown, Pa., has opened a general sales office in the Commonwealth Building in that city for the sale of its product. For the Philadelphia district, a district sales office has been opened in the new Widener Building, in charge of Edward E. Krauss, formerly secretary of the American Concrete Institute. The selling of Penn-Allen cement by the William G. Hartman Cement Company, Inc., of Philadelphia, has been discontinued.

The General Waterproofing Company, Inc., Century Building, Pittsburgh, has been organized and placed under the management of H. E. Hollingsworth, chief engineer, for the purpose of specializing in waterproofing and damp-proofing materials, waterproofing engineering and construction. Its sales department will carry a complete line of membrane and integral waterproofings, concrete floor hardener, concrete floor paints and interior and exterior wall paints. Its contract department is organized to execute work under contract or undertake supervision and is fully equipped to handle all classes of waterproofing construction on general building operations.

## Trade Publications

George A. Boyden Pump Company, Maryland Casualty Building, Baltimore, Md. Booklet,  $4\frac{1}{2} \times 7\frac{1}{4}$  in., 16 pages, illustrated. A prospectus of the business of this company, briefly outlining the pumping industry and its growth.

Gardner Governor Company, Quincy, Ill. Bulletin A-C 12, 6 x 9 in., 16 pages, illustrated. The salient features of air-lift pumping are forcefully presented in concise technical form in this publication. Gardner standard types of air compressors are illustrated and briefly described, and suggestions for their installation for water pumping given.

Busch-Sulzer Bros.-Diesel Engine Company, St. Louis. Booklet,  $6\frac{1}{2} \times 10$  in., 20 pages, illustrated. Describes the Appleton, Wis., Waterworks, which recently installed a new mechanical filtration plant, an elevated distributing reservoir, and a pumping station equipped with two Diesel engines. Unusual features of intake, filtration results from a bacteriological standpoint, economical power operation, efficiency charts, sectional perspective views, and operating plant records are included in the description. Comparing the cost of operation of the new station for April, 1915, with that of the old for its average for 1914, there is shown the startling saving of 11.9 mills per 1000 gal. in fuel cost and 10.3 mills per 1000 gal. for total cost. The systems of analysis and recording explained in this booklet should be interesting and valuable to waterworks men.